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ANNUAL MEETING OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting of the American Society of Civil Engineers, held in New York City last week (Jan. 17, 18 and 19), was signalized chiefly by the fact that it inaugurated the use of the enlarged new society house for general meeting purposes, and by the presentation of the full report of the Committee on Rail Sections. The attendance, while large and representative, was not exceptional, and the programme offered no variation in general scheme from that of previous yearly meetings. The morning session of the first day's meeting was, as usual, devoted to the election of officers, the reading of the report of the Board of Directors, the presentation of special committee reports, and routine business; one evening session was devoted to the presentation and discussion of a paper by Mr. Charles S. Gowen on "The Changes at the New Croton Dam," and the remainder of the time was taken up with excursions and the usual social functions of the annual meetings of this society.

THE ENLARGED SOCIETY HOUSE.—To the attending members a feature of prime interest was naturally the newly enlarged accommodations of the Society House at 220 West 57th St. For the benefit of the far greater number of members not present, we give here a view of the enlarged house and plans of the two main floors, in Figs. 1, 2 and 3.

The present house of the society was built in 1896, and occupied the following year. It stands on two 25-ft. lots on the south side of 57th St., near Broadway. In the past few years it has become evident, however, that the facilities of the house were not equal to all the demands put upon it. In particular, while able to handle the semi-monthly meetings, the house could not accommodate the much larger annual meetings. The library quarters also were in some respects very inadequate. Special stress was laid on these facts two or three years ago, at the time when the Union Engineering Building offer was before the society. After the vote upon this offer, by the membership, had rejected the proposal, the way was clear for speedy consideration of plans for enlarging the society's own house. In consequence, the management bought, two years ago, the 25-ft. lot adjoining its property on the west. The price paid was $100,000, as against $80,000 for the two original lots; this appreciation of 150% represents quite fairly the increased value of property in that location.

The original house was designed by Mr. C. L. W. Eidlitz, who was awarded first place in a competition for designs for the house. The planning of the extension was, of course, also entrusted to him, or rather to the firm of Eidlitz & McKenzie, of which he is a member. The cost of the original building was about $125,000; the extension will have cost about $65,000 when fully completed and furnished.

The architectural solution of the extension problem is indicated by the accompanying view, made from a recent photograph. The portion which formed the original building is here easily identified, but for comparison reference may be made to two views of the old building, published in our issues of May 28, 1896, and Nov. 25, 1897, respectively.

VIEW OF HOUSE OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS, SHOWING ADDITION.

The house of the society consists of a four-story front portion, containing the library, offices and administration rooms, and a two-story rear portion, containing the auditorium and a smoking or luncheon room. The enlargement involves both portions, and for their full present height; thus the increase of space is actually 50%. A further gain has been made, for the future, by designing the extension of the rear portion strong enough to carry several additional stories above the present roof over the auditorium.

Figs. 1 and 2 are outline floor-plans of the two main floors, the ground floor or smoking-room floor and the auditorium and reading-room floor. Referring to the former, it will be seen that the smoking-room has been increased in size, and that greatly increased toilet-room facilities are provided. In the front of the building the entrance corridor has been widened into a large, attractive hall, by shifting the secretary's office and the board room into the new part. On the second floor, the auditorium has gained 50% in size, and a room becomes available alongside the reading-room, which will probably be made part of the reading-room, thereby decreasing the handling of books between reading-room and stack-room. An elaborate book lift serves for this handling.

The upper floors (extending over the forward portion only) are, respectively, office and administration rooms (third floor) and book-stack (fourth floor). Both are enlarged one-half. On the stack-room floor the increase makes available for the first time a space suited for reference files of maps and plans, a feature which may be made of great value to the members of the society.

Like the original building, the extension is throughout of fireproof construction. The walls are brick, with gray stone trimming on the front; the floors are fireproof construction on steel beams. Columns are used at only one or two points. The auditorium roof is carried on the line of the former west wall by a heavy longitudinal plate girder resting on columns. This girder has been made strong enough to carry four or five additional stories over the extension of the rear part, to provide for possible future needs for more space.

REPORT OF BOARD OF DIRECTION.—The report of the Board of Direction shows a net increase of 336 in the membership of the society during 1905. This makes the total membership of the society 3,203 members of all classes. There was a loss of 38 members by death during the year.

Referring to the library, the report shows an accession of 3,317 items during the year; the total number of titles in the library is now 21,083. Regarding the unusual expenses of the year, the report says:

> The last report of the board contained an outline of the work of the International Engineering Congress from its inception in September, 1903, to Jan. 1, 1905. At that date the Board reported that the work of preparing the discussions was in progress, and that it was hoped to have the whole congress publication ready for issue before July 1, 1905. This expectation was realized. The discussions were collated, put in type, forwarded to the author of each paper, and, with his closure, published with the paper. All papers and discussions were grouped by subjects. The result is embraced in six volumes, issued, for convenience, as Parts A, B, C, D, E and F of Volume LIV. of "Transactions," and your board believes that the quality and extent of this publication fully justified the labor and expense which was assumed by the society.

These extra volumes were furnished without cost to all members, and were also furnished to 335 subscribers, 192 of whom paid $5, and 143, $10. A number of sets have also been sold at $5 per volume. Persons who joined the society after Jan. 1, 1905, may secure these volumes at a special price of $2.50 per volume.

Summary of Publications of the International Engineering Congress, 1905, "Transactions," Volume LIV.

Number of volumes	6
Edition	4,000
Total pages	3,398
Number of plates	248
Number of cuts	441
Number of subjects treated	36
Number of papers	96
Number of discussions	302
Separate papers printed	19,675
The total cost of the congress has been	$38,462.80
Amount expended in 1904 for this account	13,579.27
Amount expended during 1905	$24,883.53
There has been received from subscriptions and sales of publications of the congress	$24,883.53

Owing to these extra publications, the work of the staff of the society was materially increased during the year. An idea may be conveyed by the statement that of the publications alone more than 80,000 separate pieces were handled.

SOCIETY HOUSE.—In its last report the board informed the membership of the purchase of the 25-ft. lot adjoining the society house, and stated that general plans were being prepared with the expectation that the work of enlargement would go on during 1905.

The board now reports that plans for the enlargement were prepared by Messrs. Eidlitz and McKenzie early in the year. Competitive bids were secured, and on May 2, 1905, a contract was signed with William L. Crow amounting to $52,497.

Owing to the difficulty of getting steel and to some minor labor troubles, the work is not completed, but the building will be far enough advanced to enable the annual meeting to be held in it.

In a general way, the addition provides an enlargement of 50% in every department of the society's work. The lounging room and auditorium are each increased in length 25 ft. An additional reading room is provided on the second floor, and the capacity of the offices on the third floor, as well as the stack room on the fourth floor, has been materially increased.

The rooms which were used in the old building as offices of the secretary have been added to the entrance hallway, forming a new reception hall, and the entrance to the lounging room as well as the toilet facilities have been enlarged.

A stairway leading from the lounging room to the auditorium has been provided, which, it is believed, will add much to the facilities of the building, and to the comfort of those in attendance at meetings.

The building operations have been in the hands of a committee, consisting of Messrs. Noble, Deyo, N. P. Lewis and Hunt. As soon as a final settlement is made, the report of this committee will be published in "Proceedings" for the information of members.

FINANCES.—In a circular issued by the Board of Direction, dated May 25, 1895, when the building of a society house was first contemplated, the available assets of the society were stated to be as follows:

The house, 127 East 23d St. (estimate)	$80,000
Securities in safe deposit (par value)	16,000
Cash awaiting permanent investment	4,500
Total	$80,500
Mortgage on 127 East 23d St.	$80,500
Amount available	$64,500

When the enlargement of the society house is finished and paid for, a similar statement will be about as follows:

Lot (75 x 112) 218-222 W. 57th St. (estimate)	$270,000
House (1897), cost	103,500
Addition (1905-06) (estimate)	60,000
Total	$433,500
Mortgage and loan	190,000
Total value of real property, above debt	$243,500

It should be noted that the above statement relates only to the real property of the society, and does not show the increased value of the library nor the amount expended for furniture, etc.

The secretary's report on receipts and disbursements during 1905 is given in the accompanying table:

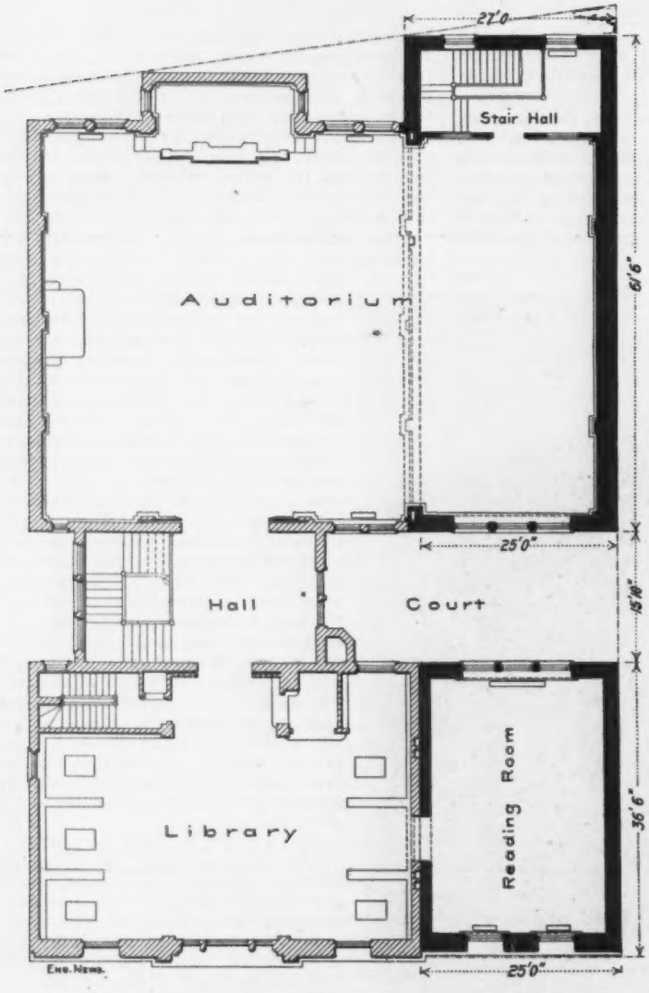


FIG. 2. PLAN OF SECOND FLOOR, ENLARGED HOUSE OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

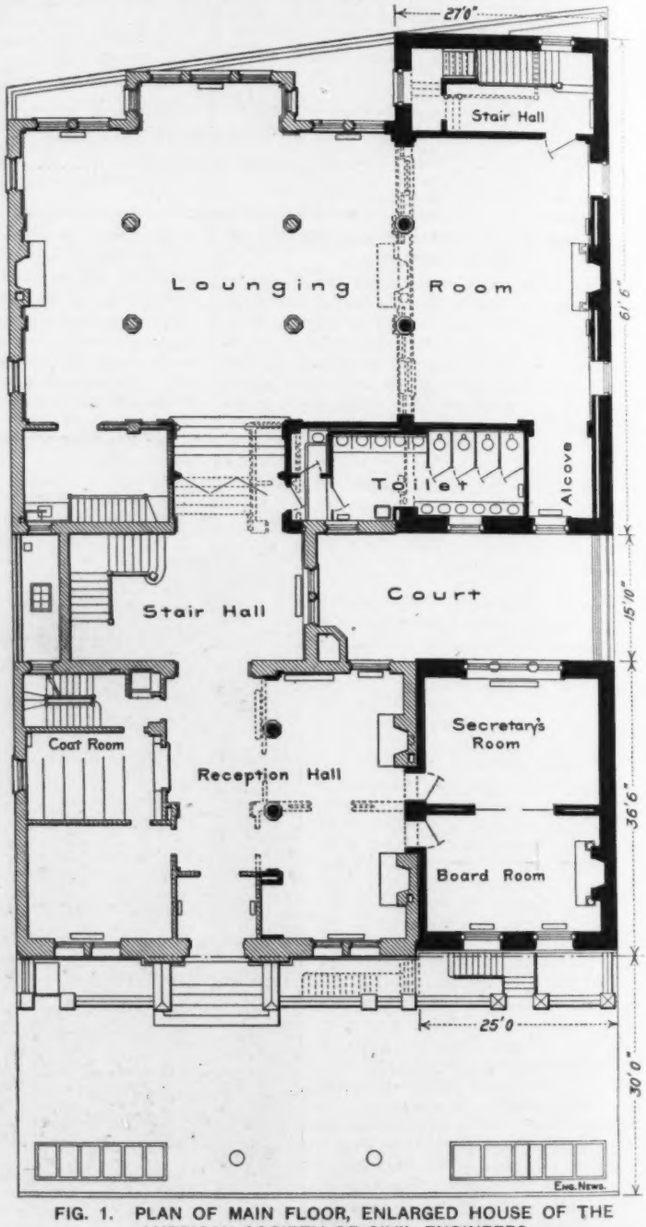


FIG. 1. PLAN OF MAIN FLOOR, ENLARGED HOUSE OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

Table Showing Receipts and Disbursements by the American Society of Civil Engineers for the Year 1905.

RECEIPTS.

Balance on hand Dec. 31, 1904	$49,927.49
Entrance fees	9,065.00
Current dues	37,642.58
Past dues	1,519.71
Advance dues	17,595.11
Certificate of membership	352.75
Badges	2,014.50
Sales of publications	2,501.98
Interest	987.07
Library	272.85
Convention	507.00
Annual meeting	894.00
Binding	7,676.80
Miscellaneous	112.70
Donation	5,000.00
International Engineering Congress	2,333.84
Louisiana Purchase Exposition	193.80
Entertainment of British Engineers	80.00
Loan and mortgage	3,000.00
	$92,351.33
	$142,279.42

DISBURSEMENTS.

Salaries of officers	$8,500.00
Clerical help	12,323.35
Caretaking	1,771.94
Publications	15,374.13
Postage	3,763.33
General printing and stationery	2,324.51
Badges	1,636.90
Certificates of membership	222.70
Binding	6,542.79
Library	1,079.98
Maintenance of house	285.80
Heat, light and water	1,116.50
Furniture	201.50
Annual meeting	1,528.25
Convention	1,131.51
Prizes	179.85
Interest and insurance	8,678.98
Petty expenses	185.49
Entertainment of British Engineers	172.50
Building	36,888.55
Louisiana Purchase Exposition	31.25
Refunds	10.35
Current business	441.17
International Engineering Congress	24,932.93
	$129,322.17
Balance on hand Dec. 31, 1905	12,957.25
	$142,279.42

FRAUDULENT GOVERNMENT LAND SURVEYS IN WYOMING.

By E. J. F.

During the summer of 1905 the writer spent his vacation in the Big Horn Mountains some twenty miles west of Buffalo, Johnson County, Wyoming. The purpose of the expedition was to obtain some specimens of the flora of the mountains in this section and in so far as this is concerned the trip was entirely successful. This portion of the Big Horn Mountains is drained by Clear Creek and tributaries on the east. From Buffalo, Clear Creek runs northeasterly to its junction with Powder River, some fifty miles distant. West of Buffalo the course of Clear Creek is nearly east and west. Two small tributaries of Clear Creek flow into it near the town of Buffalo. The first of these, going down stream from Buffalo, is French Creek and the second is Rock Creek. About 25 miles below Buffalo the main tributary of Clear Creek joins the parent stream. It is called Piney Creek.

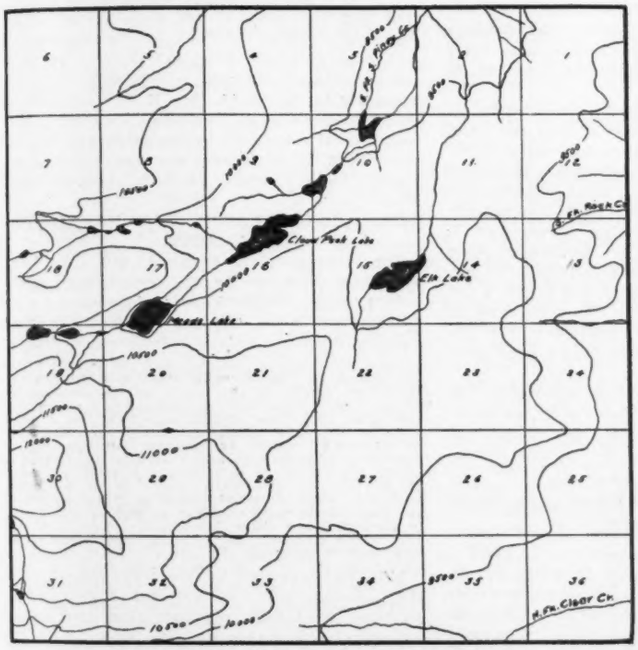
Before leaving the east I secured a topographic sheet of the "Cloud Peak Quadrangle" from the United States Geological Survey. This map covers the country visited by me during the summer. Before leaving Buffalo for the mountains I also secured copies of the U. S. Land Office maps showing, or pretending to show, a portion of the same country. In comparing the two, prior to my departure, I found that there was a great difference in the maps and for this reason I was interested in checking the two upon the ground. To show how inaccurate the land office map is I have taken one township plat as a typical example. From Buffalo the country looks as though French Creek and Rock Creek flowed directly from the high mountains to the west. The truth is that both streams are cut off by Piney Creek which rises on the slopes of Cloud Peak and runs northeasterly, as shown by the U. S. Geological Survey map. It would seem that the land office surveys were made in a tent near Buffalo and I was unable to find a person who had been able to find a monument on the mountains such as the maps would indicate had been set. I found no signs of monuments of any kind.

As a further indication that the surveyors who made the land office surveys did not get intimately acquainted with the country it will be noticed that the land office map shows Rock Creek and French Creek running through the entire township in an easterly direction. The topography of the land office map has been drawn with the evident intent of making the country agree with the water courses. The truth is that French Creek does not touch the township at any point and Rock Creek has its source in Sections 12 and 13. In making the land office survey eighteen large lakes were overlooked. One of these lakes is over a mile long. It will soon be utilized as a reservoir and the parties who are interested in its construction were compelled to locate it by running an independent line from the foothills at a cost of $800. From this private survey it has been possible to lay out the section lines on the topographic map of the United States Geological Survey. This has enabled me to give the matter some further study.

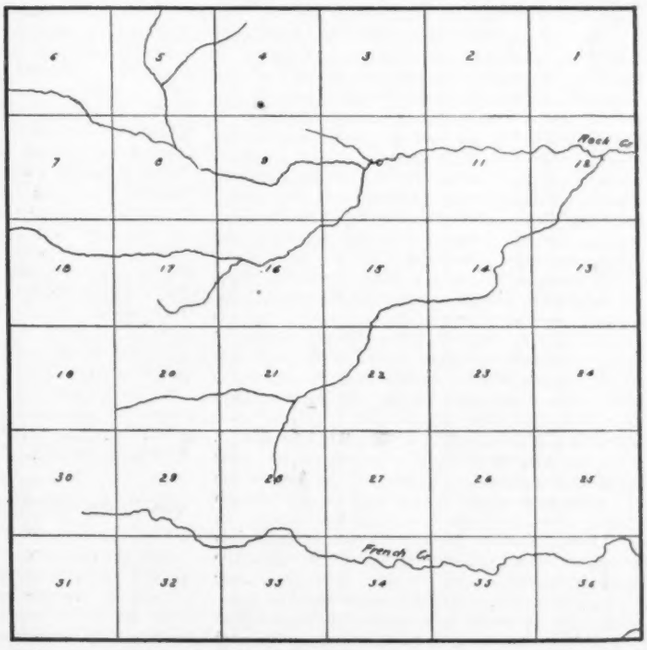
The field notes state that the quarter corner between sections 14 and 15 is indicated on the ground by a post 3 ft. long and 3 ins. square. The witness is a mound of stone. It seems strange that such a corner should be placed in a lake where the water is probably 25 ft. deep! Again, the quarter corner between sections 8 and 9 is described as follows: "Granite stone, 12 × 10 × 10 ins., mound of earth." This corner is located on an extremely rough, rocky mountain side, almost at timber line and there is not a spoonful of earth within a half mile at least. We can see why such a corner was described by looking at the plat furnished by the land office. Upon that map Rock Creek is supposed to flow near this quarter corner. If it did there might be some earth, but Rock Creek is actually four miles away.

The longer I remained in the mountains, the more I learned to appreciate the topographic work of the U. S. Geological Survey and the less use I had for the land office maps. When I returned to the settlements along Clear Creek east of the mountains, I made inquiries regarding the public land surveys and what I learned served to fully convince me that the early surveys made by the land office in Wyoming were largely fraudulent. It would seem that Wyoming, like some other Western States, had been the victim of Benson, the famous Californian and his adherents. The man who was supposed to have subdivided Township 51 North, Range 85 West, came to Wyoming with the Benson party. It is said that he was once asked regarding the inaccuracies found in this work and he replied "When the Government was doing this work it was paying for field notes, not for monuments." I found that this man was still doing work in Wyoming, although he had been suspended during the time W. A. Richards, Commissioner of the General Land Office, was Surveyor-General for Wyoming. The present Surveyor-General, I was informed, is a brother-in-law of Mr. Benson. Resurveys have been necessary and many more will have to be made. Much of this work has been done by the men who were originally associated with Benson in his now famous "tent surveys."

I am urged to give some expression of my convictions of this kind of work because I feel that the burden does not fall finally upon the Government, but upon the people for whom the surveys were made. Resurveys after settlement has begun only add to the difficulty. A map which does not represent the truth is worse than nothing, while such a topographic sheet as that furnished by the Geological Survey was a never-ending source of information. I trust that the land office maps may soon be brought up to the same standard.



Map Published by the U. S. Geological Survey.
(Section Lines Added.)



Map Published by the U. S. Land Office.

TWO OFFICIAL U. S. GOVERNMENT MAPS OF THE SAME TOWNSHIP IN NORTHERN WYOMING.

FOR THE SANITARY PROTECTION of Hemlock Lake, the source of the Rochester water supply, the city named secured authority, in 1895, to buy a strip of land surrounding the lake and within 200 ft. of the high-water mark. Some land outside the limit named was also acquired. Of a total frontage of 15.93 miles, the city had acquired, up to Dec. 9, 1905, a total of 14.62 miles. The cottages and hotels on this land, which gave rise, in large measure, to the desire to buy the land, have been removed. Only a half dozen cottages or so now remain at the lake. As some of our readers will remember, the City of Rochester maintained, for a number of years, a pail system for the removal of wastes from the cottages and hotels, most of which were occupied in the summer only. Up to July 1, 1900, the land purchases at the lake were made by commissioners, but since that date they have been made by the Commissioner of Public Works. The foregoing information has been furnished, at our request, by Mr. Edwin A. Fisher, City Engineer of Rochester, N. Y.

AN IMPROVED FORM OF ELECTRIC EXPLODER FOR BLASTING.

By J. Schuermann.*

In America, in blasting operations of any magnitude, it is universal practice to explode the charge by electricity. As is well known, in firing blasts by electricity the exploder is the vital factor. Unless this device is reliable and uniform in action trouble is certain to result. A few words will explain the reason.

Fig. 1 is a section of an ordinary electric exploder. It consists of a metal shell or cap c about half filled with firm fulminate of mercury d. Into the open end of the cap are inserted two insulated fuse wires b, b, with their ends bared and connected by a platinum wire soldered to them so as to form a bridge a. The bared ends of the fuse wires and the platinum bridge are buried in a loose primer e, and the whole is sealed in position by a plug of sulphur cement f. The current through the fuse wires, in passing the bridge, heats it red-hot and explodes the cap.

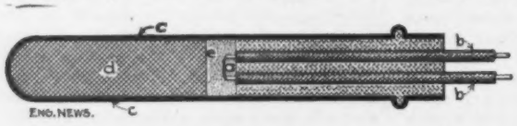


FIG. 1. DIAGRAM SECTION SHOWING USUAL CONSTRUCTION OF ELECTRIC EXPLODERS.

From the preceding description it will be seen that it is vitally necessary to the usefulness of the exploder that the bridge connection shall be perfect and that the resistance it offers to the electric current shall be absolutely uniform. If the connection be broken, the exploders will not discharge at all. If, however, the connection is perfect, but the resistance varies, then in firing a number of holes the exploders with less resistance will not explode together with those which have a higher resistance, and the result is that some holes miss; but they can be fired afterwards separately. Of course the separate firing of shots will spoil the success of the blast.

Every exploder manufacturer tests his exploders, and in order to get successful blasts, he pays particular attention to their uniform electrical resistance, because the best exploders are those which have the most uniform resistance in all the platinum wire bridges.

In the ordinary exploder illustrated in Fig. 1, with the bridge soldered directly to the fuse wires, the electrical resistance of the bridge can be tested only in connection with the full length of fuse wires, which may be anything from 4 ft. to 100 ft., or over. Now, wire cannot be drawn which is of such exact uniform size that the electrical resistance in 10 ft., 20 ft., 30 ft., or any other length of double conductor, is absolutely the same at all times for each given length. Furthermore, the longer the conductors (fuse wires) the greater will be the difference in electrical resistance between different wires of the same length. In a word, 10 double conductor fuse wires, say 30 ft. in length, when tested, will give 10 different (of course, triflingly different) resistances. A test, for example, will analyze something as follows:

Exploder.	1	2	3
Resistance of 30-ft. double conductor No. 21 fuse wire	1.10	1.15	1.19
Resistance platinum wire bridge	0.63	0.58	0.54
Total resistance	1.73	1.73	1.73

It will be noted that, while the total resistance for each exploder is the same, the bridge resistance for each is different.

In order to get away from the error resulting where the fuse wires, plus the platinum bridge, are tested together, and to make sure that the test results always give the absolute resistance of the platinum bridge, the improved form of exploder shown in Fig. 2 has been devised. The platinum wire bridge is made separate from the fuse wires in the form of a little about ½-in. long match, which can be tested for resistance before it is fixed to the fuse wires. Referring to Fig. 2, the platinum wire bridge p is soldered to two conducting metal foils m, which are separated by an insulating material i. Instead of pouring loose primer on top of the fulminate d, the end of the match is dipped into a priming composition, which adheres in a globule c embedding the bridge. This envelope of solid primer tends to preserve the fine bridge wire from breakage in handling and shipping, and it also has the advantage of bringing the wire in closer contact with the priming material than is possible when the primer is in the form of a loose powder.

The chief advantage of this form of exploder is that the absolute electrical resistance of the bridge wire can be determined and regulated by test. For example, with the improved exploder, the test noted above would analyze as follows:

Exploder.	1	2	3
Resistance of 30-ft. double conductor No. 21 fuse wire	1.10	1.15	1.19
Resistance platinum wire bridge	0.60	0.60	0.60
Total resistance	1.70	1.75	1.79

The total resistances of fuse wires, plus platinum wire bridges, are different, but the platinum wire bridge has the same resistance in every exploder, whatever the length or diameter of the conductor.

The advantage of the absolute uniformity in electrical resistance obtained by the improved exploder described is that it makes the simultaneous firing of many separate charges especially certain. As examples, the great Henderson's Point blast at the U. S. Navy Yard, Portsmouth, N. H., fired July 22, 1905 (Eng. News, Aug. 3, 1905), and the large blasts on the Pennsylvania R. R. work between Columbia and Safe Harbor, Pa. (Eng. News, Dec. 28, 1905), may be cited. At Henderson's Point 900 exploders were fired at one shot, and in Stigerwalt's blast on the Pennsylvania R. R. work 1,600 exploders were fired at one shot.

In conclusion, it is proper to state that the improved exploder described here is manufactured by the Star Electric Fuse Works, of Wilkes-Barre, Pa.

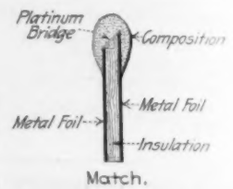


FIG. 2. DIAGRAM SECTIONS SHOWING IMPROVED CONSTRUCTION OF ELECTRIC EXPLODERS.

*Wilkes-Barre, Pa.

ANNUAL CONVENTION OF THE AMERICAN INSTITUTE OF ARCHITECTS.

The thirty-ninth annual convention of the Institute was held at Washington, D. C., on Jan. 9, 10 and 11. In the opening address of the President, Mr. W. S. Eames, he referred to the Seventh International Congress of Architects, to be held in London in July next, and stated that the Institute would be officially represented by a delegation. In 1907 the Institute will complete its fiftieth year, and it was suggested that the convention to celebrate that event should bring together not only the fellows and associates of the Institute, but a notable representation of the allied arts—painters, sculptors and decorators, educators and the literary world, and all others having an interest in the advancement of the art of architecture.

The report of the Board of Directors showed a total membership of 759, of which 339 are fellows and 420 associates. We quote the portion of the report relating to the artistic development of cities, as follows:

The question of Municipal Improvement is a broad and interesting one to the whole community. The initiative of the American Institute of Architects in the improvement of Washington was the first step towards the appointment of the Park Commission. The report of that commission had a great influence in developing and increasing this movement. The following cities have taken up the subject actively and systematically: Washington, Baltimore, Philadelphia, Hartford, Boston, New York, Brooklyn, Buffalo, Cleveland, Chicago, St. Louis, New Orleans, Seattle, San Francisco, Providence, Cambridge, Berkeley, Chautauqua, Cincinnati, Detroit, Los Angeles.

The following schools are showing the effect of this impulse by having studies made for the systematic grouping of buildings: Annapolis Naval Academy, University of California, Harvard, Cornell, Leland Stanford Junior University, Columbia, George Washington, Yale, Princeton, West Point, Oberlin.

Mr. Tashima, Government Architect for the Island of Formosa, spent nearly a year in this country studying the subject of a plan for a new capital city for the Japanese Government, which has determined to lay out a new capital city for the Island of Formosa. He proposes to recommend the principles of the plan of Washington for the new capital city on the Island of Formosa. The Federal Government has directed the preparation of a scheme for a systematic development of Manila of which Mr. D. H. Burnham is the architect in charge. The new Federal Buildings in Washington City are now being erected in accordance with the program laid out by the Park Commission.

Several important papers were read in connection with this subject. Mr. Clarence Zantzinger described the plan for the aesthetic improvement of the banks of the Schuylkill River in Philadelphia, which, he said, were now probably the most unsightly in the world. Mr. E. D. Litchfield described the municipal improvements being undertaken by the Borough of Brooklyn and Greater New York. A paper was also contributed by M. Eugene Henard on the "Artistic Development of Paris."

THE STRIKE CLAUSE IN BUILDING CONTRACTS.

The Committee on Contract and Lien Laws recommended a change in the so-called "strike" clause in the standard form of contract by inserting the word "general" before the word "strike," so that the clause would read as follows:

"Art. VII. Should the contractor be delayed in the prosecution or completion of the work by the act, neglect or default of the owner, of the architects, or of any other contractor employed by the owner upon the work, or by any damage caused by fire or other casualty for which the contractor is not responsible, or by general strikes or lockouts caused by acts of employees, then the time herein fixed for the completion of the work shall be extended for a period equivalent to the time lost by reason of any or all the causes aforesaid, which extended period shall be determined and fixed by the architects; but no such allowance shall be made unless a claim therefore is presented in writing to the architects within forty-eight hours of the occurrence of such delay."

This was approved by the joint committee of the Institute and the National Association of Builders, with only one dissenting vote; but a supplementary statement was included in the committee's report, as follows:

In view of the objections of some members of the Institute to the "strike" clause and of some of the contractors to the word "general," of the action of the architects and contractors in St. Louis, and of the ingenuity of the unions in causing a practical strike at any time without passing a specific vote or issuing a specific order, and at the same time recognizing the justice of giving a contractor an extension of time when his work is obstructed and stopped by conditions beyond his control, your committee has prepared as a substitute for the words "or by general strikes or lockouts caused by acts of employees," the following: "or by combined action of the workmen, in nowise caused by or resulting from default or collusion on the part of the contractor," and would be glad of an expression of opinion by the convention as to the propriety of the change and as to its affording equitable protection to both the owner and the contractor.

The above report was referred to a committee, which at a later session reported as follows:

The suggestion of an amendment to the so-called strike clause by substituting, "or by combined action of the workmen, in no wise caused by or resulting from default or collusion on the part of the contractor" for "or by general strikes or lockouts caused by acts of employees," would appear to be more just and equitable to both parties to the contract, and it is recommended

that the convention request the committee to submit the same to the jurist committee of the Institute of the National Association of Builders for adoption.

ARCHITECTURAL COMPETITIONS.

This subject attracted more attention and consumed more time in discussion than any other brought before the convention. A long report was presented by a special committee of the Association, and it was discussed at great length by Messrs. R. D. Andrews, Cass Gilbert, W. B. Mundie, John M. Donaldson, Geo. B. Post, John M. Carrere and others. A motion was finally carried that a committee of five shall be appointed to consider the whole subject of competitions and report to the Board of Directors, which should in turn study the subject and prepare a statement which shall be sent to every member of the Institute, and that the whole matter be made a special order of business for the annual convention of 1907. The paper of Mr. Mundie, around which much of the discussion centered, was substantially as follows:

The American Institute of Architects has a code for the conduct of competitions. What we need most is a code for the conduct of competitors.

I have attended every institute convention for the past ten years and every meeting but one of the Board of Directors for the past three years and I believe I speak correctly when I state that the sins of omission and commission of competitors and competitions has come up in some form or other at every meeting. It is time to stop theorizing and criticising.

Condemnatory resolutions are of little value when we ourselves have been the real sinners. This business of competitions is going to get worse instead of better unless we organize on an entirely different basis.

We must consider the varying types of mankind. Many cannot hold back from temptation for the sake of the good of all. Many are selfish, others are ambitious and there are others who approve of the competition scramble under the guise of advance of art, and so on through the whole gamut of dissimilarity of men.

Now we march up the hill and now we march down again, and the young architect of to-day who is the institute man of to-morrow asks the question what do we stand for? And is it any wonder when we see the pitiful finish of the late competition for the new court house for Cook County in Chicago, the program for which was commented on in the report of the Board of Directors this morning. To many here who do not know the outcome of that competition, I will make it as brief as possible. The competition was a mixed one, a type permitted under our present code. Several were invited and paid a certain stipulated sum, while any other architect who had been in practice for two years previous to entering the competition was invited to compete for prizes aggregating $8,500—$5,000 to the first premiated design—$2,500 to the second premiated design and $1,000 to the third design, while the seven invited competitors not receiving a prize were paid the sum of $1,000 each—which made $3,000 [?] more of the taxpayer's money paid out for what?—ostensibly for the purpose of awarding the commission to the winner of the competition.

The cost of the building was set forth in the program not to exceed $3,500,000. What a splendid opportunity for the taxpayers to secure a creditable building. The prizes were of ample inducement to attain good results, but the program was sadly at fault. To the credit of the profession only thirteen designs were submitted in competition, and many members of the profession declined even after being invited to compete. The committee of experts awarded the premium to a design submitted by one of the open competitors, and their report closes as follows:

We therefore recommend that, inasmuch as the design No. 1 presents the most attractive exterior and the plans numbered 5 and 6 the most convenient interiors, the commissioners instruct the work to the authors of one of these two designs conjointly with the author of No. 1, making such arrangements as to the share of each in the work as shall be accepted to them and to the County Commissioners.

In other words it was a cold storage egg and had to be scrambled.

Now I do not wish to take up too much time with professional ethics and an essay on the soulful poetry of architecture. I leave that to others, confining myself strictly to the prescriptive cure to check this prevalent epidemic, and I am tired of this everlasting journey uphill and down again, and seeing the small fellow being compelled to take a full allopathic dose and the big fellow getting off with a homeopathic dose much diluted and graded in accordance with his standing.

I will therefore come to the point where I present a new complete code of competition for the American Institute of Architects.

Our present code of competition is too comprehensive. It is filled with provisions that permit changes and alterations to be made so that its spirit and intention may be sadly at variance with its ethical meaning.

The code I present is based upon the idea that our present by-laws will be so amended that any unprofessional conduct on the part of competitors will be promptly dealt with by the vote of censure after a fair trial that is drastic enough to prove efficacious, as has been proven in one or two instances heretofore.

The American Institute of Architects recommends that wherever possible an architect be employed without a competitor. When a competitor is deemed necessary the procedure must be in accordance with the following code:

FORM OF COMPETITION.

A. The competition must be limited to a certain number of architects, each of whom is invited to take part.

B. Each competitor to receive a certain sum of money to reimburse him for the expense incurred. This sum to be agreed upon between competitors and prospective client, and this sum to be paid to each competitor other than the one awarded the commission, or a prize, if prizes are agreed upon.

C. The author of the design receiving the first mention by the jury must be employed to design and superintend the erection of the building.

JURY OF AWARD.

The jury of awards must consist of not less than three members, and a majority of the jury must be members in good standing in the American Institute of Architects, and the entire jury of awards to be agreed upon between competitors and prospective client.

PROGRAM.

The program must be drawn so as to form a contract, and be signed by all competitors and prospective client.

RULE OF CONDUCT.

A. All designs must be signed by the name of the competitors submitting designs.

B. No member of the American Institute of Architects shall enter a second competition for the same building unless he was a competitor in the first competition.

C. No change or deviation from this code shall be permissible until such change shall receive the sanction of the Executive Committee of the institute.

D. It shall be deemed unprofessional for any member of the American Institute to violate any of the provisions of this code.

E. It shall be deemed unprofessional for any member of the American Institute to enter any competition based upon this code with any competitor who has been once censured for unprofessional conduct in competitions conducted under this code.

In accordance with a recommendation in the President's address, the following resolution was adopted:

Resolved, That the President and Directors arrange some signal honors, such as they judge best, to be offered at the next convention to such persons as the directors decide have done most for the profession or the institute during the fifty years of its existence.

A motion was carried to create a special committee of five on "Specifications," to report to the Board of Directors and the separate chapters of the Institute and to the annual convention of 1907.

Much time was spent in discussion of the method of making nominations for the official positions in the Institute, and the following resolution was finally adopted:

That the directors be requested to appoint a committee to consider and report upon a method of making two sets of nominations, and that each set be given status on the ticket without distinction.

The officers elected to serve for the ensuing year were as follows: President, Frank Miles Day, Philadelphia, Pa.; First Vice-President, Cass Gilbert, New York, N. Y.; Second Vice-President, William B. Mundie, Chicago, Ill.; Secretary-Treasurer, Glenn Brown, Washington, D. C.; Directors for three years, Alfred Stone, Providence, R. I.; Irving K. Pond, Chicago, Ill., Ralph Adams Cram, Boston, Mass.; Director for two years, Merritt J. Reid, San Francisco, Cal.; Auditor, James G. Hill, Washington, D. C.

REPAIRING ENGINEERS' FIELD INSTRUMENTS.

By E. M. Douglas.*

The writer has frequently noticed the lack of ability on the part of many engineers to make minor repairs to their field instruments. If one is so unfortunate as to fall while carrying an instrument it generally results in so damaging it as to render it useless to the average assistant. At such times the man with some mechanical skill and a few simple tools can make at least temporary repairs, and thus save his employer considerable expense. In such an emergency an engineer who will not make an earnest attempt to repair the damage is not deserving of that honorable title. Every engineer whose work takes him some distance from a city should keep with him a few tools, such as a pair of flat pliers, a small file, large and small screw drivers, a spool of soft brass or copper wire, a pocket knife, also an extra level phial, an ounce or two of plaster of paris, and a bottle of liquid shellac.

The young engineer should be familiar with the details of construction of the instruments he uses, and it is to be regretted that more instruction is not given in technical schools on this important subject. The catalogues of most instrument makers give valuable information regarding their own instruments, and also many suggestions of general application, which it would be well to study carefully.

Suppose a transit has a fall; the standards are probably bent and a level vial broken. Many men would start for town at once under such circumstances, and possibly lose several days' time in having repairs made, but remember that the successful engineer is the one who "does things" and never admits that he is "stumped." If you are of this kind, take the transit apart, lay the bent standard on a flat block of wood, and with another block of wood and a hammer or mallet proceed to straighten it. This will not be an easy task, but it can be done. The level tube should then be taken apart and cleaned out, the extra level vial inserted and blocked up with a leaf from the note book, taking care to get the marked or convex side of the tube uppermost. If the level divisions are not cut on the glass, look for a small file scratch near one end of the vial, or if that is not apparent, put that side up which shows inside signs of grinding. Mix up a spoonful of the plaster of paris with water and place a portion around each end of the glass. In a few minutes this has hardened and the tube can be replaced.

Is one of the adjusting screws broken? Whittle out a new one from a piece of hard wood, fastening that end also if necessary and possible with a piece of copper wire.

Broken tripod legs are easily repaired with a piece of wood and some string or wire held in place by shellac. You may not make a neat job of your repair work, but don't mind that if you are able to complete the work assigned you without loss of time.

The writer has in mind a man of considerable skill in certain lines, who had "accepted" an offer of a responsible position and had been placed at work. As a result of a moment's carelessness, an alidade ruler was slightly bent, and without attempting to repair it he rushed to the nearest telegraph office and sent a message to his chief reading: "I have bent my alidade ruler. What shall I do?" The answer which came was, "Straighten it." This he easily did. At another time a levelman telegraphed: "Cross wires broken, send another level," although he knew that to do so would result in a delay of several days, but the answer he received was, "If you can't insert new cross wires disband your party," and with the possibility of discharge as a stimulant he found that the repairs were easily made. Still another levelman, who could not catch his chief by telegraph, stopped the work of his party and sent his Y level nearly 1,000 miles to an instrument maker in order that the eye piece might be centered on the cross wires. He could have remedied that trouble in five minutes by the proper manipulation of a screw driver. No error would have been introduced into his work, even if the cross wires were not in the center of the field of view so long as the usual level adjustment had been made. This man had not learned to distinguish between a blemish and a fatal defect.

During the past year in certain instrumental work under the writer's charge an expense of over $50 was incurred in having new cross wires inserted by an instrument maker, not including the loss of time by the various parties.

Broken cross wires are of frequent occurrence and are easy to replace if one knows how, consequently the writer is now requiring his assistants to learn how, and in order to aid them has prepared a description of the process, which, as it may be of use to others, is here given in full:

A small bottle of shellac dissolved in alcohol (preferably a thin solution, as that will dry quicker) and a cocoon of spider web are needed. The only tools required are a pair of dividers, or a 6-in. piece of soft iron or copper wire bent to a U,

*Geographer, U. S. Geological Survey, Washington, D. C.

but if neither is available a forked stick will answer. The dividers, wire or forked stick should have a small piece of beeswax pressed around each end to hold the web. A couple of small pointed sticks the size of matches are useful.

The best cocoons for ordinary use are yellowish brown, about ¾-in. long; they may usually be found in dead or hollow trees, or under the bark of old stumps. Good ones may often be found under rocks or in old barns or greenhouses. Occasionally single webs, which may be used in an emergency, may be taken from grass or bushes or limbs of trees; these are generally rough and dirty, but some of their defects may be removed by gently rubbing them with a small stick. If a very fine web is needed it may be secured from a small white cocoon. A good cocoon will furnish enough webs to last for years, and each chief of party should have one packed with the shellac in his instrument box. The best web obtainable can be secured by making a spider spin one as he falls from the end of a stick. A small spider will probably spin a fine web, and a larger spider a coarser web; such webs are always smooth and free from dust. If the spider is made to jump from the end of the dividers or forked stick, the web can be wrapped around the ends and so be in position for immediate use.

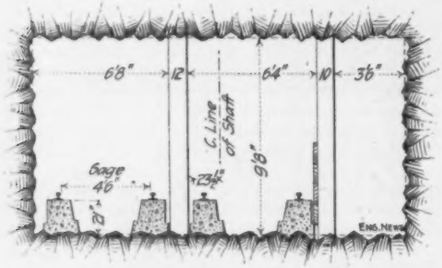


Fig. 1. Cross Section of Inclined Shaft with Concrete Track Stringers; Ahmeek Mine, Calumet, Mich.

Take the instrument which needs the new cross wires to a place sheltered from wind and dust. Unscrew and remove the eyepiece slide without disturbing the object glass. Take out two opposite capstan-headed screws of the four which hold the cross-wire ring in its cell and loosen the other two. Using the latter as handles, revolve the ring 90° and insert one of the pointed sticks through the end of the telescope tube into a screw hole, and, while using it as a handle, remove the other screws and take out the ring. Clean the lines of the reticle ring from all old shellac or dirt and lay it on a board or table with the marked side up. Draw some of the web from the cocoon, either with the fingers or with one of the moistened pointed sticks. Keep pulling and working the tangled mass until an inch or two of single web is drawn out. Attach the ends of the web to the dividers, or wire, by winding them around the wax and pressing them in with the fingers, or wind the web around the forked stick, fastening it with shellac. Examine the web for defects by means of a pocket magnifier or the eyepiece from the telescope. If the web is satisfactory in size and quality, moisten it by dipping it in water for a few seconds, or by breathing gently on it a few times. As the wet web lengthens, take up the slack by opening the dividers, or by bending the wire or stick, but do not attempt to stretch the web more than about 1-16-in. from its original dry length. Place the web (still on its holder) carefully over the reticle, allowing the holder to rest on the table, thus stretching the web slightly, and move it about until it falls exactly in the center of two opposite lines, using a magnifier to insure accuracy. Put a small portion of the liquid shellac over each side of the web about 1-16-in. from central opening of the reticle and leave undisturbed for three or four minutes, or until the shellac hardens. While the shellac on one web is drying another can be prepared. After all are set, replace the reticle in the telescope by reversing the method used in removing it. When in place the cross wires should be on the side of the rig toward the eyepiece.

Instruments such as the prism level, dumpy levels and transits, not provided with wyes or similar devices for adjusting the cross wires, may be put in close adjustment by means of improvised wooden or metal rings in the following manner:

For the prism level, the body of which has a cloth finish, remove the object-glass cap and run the eyepiece slide part way out as though focussing for a near-by object. Provide a Y of wood or metal large enough to fit over the object-glass end of the telescope where the cap usually fits. Take a second Y of a size suitable to enclose the eyepiece slide near the main telescope tube. Fasten these Y's securely in an upright position and rest the telescope in them, sight a distant point which the cross wires cut, revolve the telescope in the wyes and adjust the cross wires in the usual way. A final adjustment must be made for such instruments as this by the usual methods.

But prevention is always better than cure, and a great many instrument troubles may be prevented by care in handling the instruments and by the frequent application of a little oil (a very little will answer) to spindles, leveling screws, tangent screws and telescope slides. An occasional cleaning with an oily rag will work wonders. Never over strain a screw, make it snug and no more.

The workman who takes care of his tools, who learns to do good work with the means available, is not the man who fills his report with excuses. He knows it is results that are wanted, not excuses.

CONCRETE STRINGERS FOR TRACKS IN MINE SHAFTS.

The use of concrete stringers to support the rails in an inclined mine shaft was referred to by a correspondent in our issue of Nov. 23, and we illustrate herewith this interesting piece of work at the Ahmeek copper mine near Calumet, Mich.

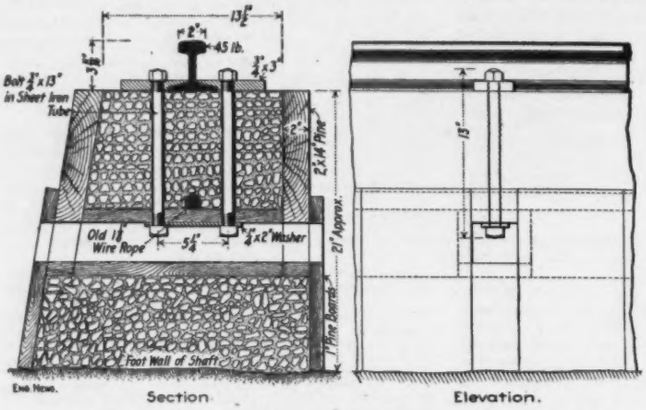


FIG. 2. CROSS SECTION OF CONCRETE STRINGERS AND MOLD.

The shaft has a dip of 42° from the horizontal, and by the cross section of the shaft, Fig. 1, it will be seen that there are two tracks of 4 ft. 6 in. gage for the skips. Each of these has two lines of concrete stringers, Fig. 2, to which the 45-lb. rails are secured by clips and nuts on anchor bolts spaced 3 ft. apart. The bolts are threaded at each end, and pass through sheet iron tubes or sleeves which are placed in the forms before the concrete is deposited. The bottom nuts bear against a washer plate, while the upper nuts secure the rail clips, which, however, are now of slightly different form from those shown on the drawings. Figs. 2 and 3 show the construction of the molds, which are in lengths of 15 ft.

It was found in sinking the shaft that the average depth of stringer, measured at right angles to the dip of the shaft, was about 22 ins. Before placing the molds, all loose ground was removed from the foot-wall of the shaft, and after placing the molds the foot-wall was washed down, making a clean face inside the molds for the concrete to rest on. These stringers have been in use about one and a half years and are giving good satisfaction. The concrete is composed of 1 part Portland cement, 3 parts sand and 5 parts broken stone; the prices of material were $1.88 per barrel for cement, 73 cts. per cu. yd. for sand, and $1.13 per cu. yd. for crushed stone. The total cost of 90 lin. ft. of single track (two stringers) was $200.85, including all labor and materials (but not including cost of molds). The average cost per lin. ft. is $2.23, or approximately $4.46 per lin. ft. for two tracks or skip roads.

For drawings and information we are indebted to Mr. W. J. Uren, superintendent of the Ahmeek Mining Co., Calumet, Mich. He states that by this construction all timber work is dispensed with (except the dividers), thereby reducing the fire risk; and that as a rule the expense of equipping a shaft with concrete stringers will be less than that of timbering.

THE OPERATION OF A BUSY RAILWAY TERMINAL.*

By C. H. Ketcham.†

According to a statement dated March 10, 1902, the Delaware, Lackawanna & Western R. R. were handling 29,847 suburban passengers in and out of its Hoboken (N. J.) terminal per day. At the present time we are handling 40,163 per day, 45% of the number being handled in four hours.

In passenger yard we have a track capacity for 410 coaches, consisting of ten tracks, eight to eleven cars each, for receiving and dispatching trains, three storage yards, situated north and south of the eastward and westward main tracks, all equipped with gas, steam and water, so located that train can be switched from receiving tracks, storage yards or vice versa. Yard arrangements include "scenery track," Pullman car track, express, and track for the handling of 44 cars of milk per day.

In order to promptly clear the receiving tracks to take care of suburban trains arriving during rush hours on a minute headway, road engines are used to kick their own trains out of the receiving yard into the storage yard. Otherwise the receiving tracks would not be cleared fast enough. Trains made up of sleeping cars or private cars are handled only by engines attached.

While some of the cleaning of coaches is done in outer yards on the division, such as sweeping and dusting, the thorough cleaning of all coaches, milk cars, baggage cars and sleeping cars, is done at Hoboken Terminal, necessitating prompt handling of these cars to and from cleaning tracks in order to get them in proper shape prior to the dispatching of trains. At one time certain

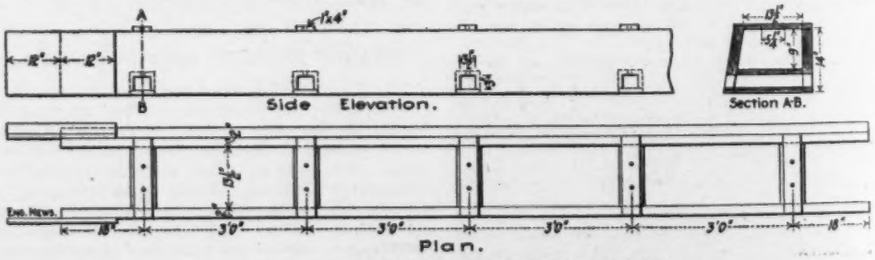


FIG. 3. MOLD FOR CONCRETE STRINGERS.

*Extract from a paper presented at the meeting of the New York Railroad Club on Jan. 19.

†Division Supt., D. L. & W. R. R., Hoboken, N. J.

cars were assigned to certain trains, but with increased business and to get the best movement out of the total number of cars, this has been done away with, with the exception of a few trains, such as club trains, where regular equipment is assigned. A combination baggage car is, however, assigned to each conductor.

The passenger terminal service is taken care of by three yard engines days and two nights. The day engines have a conductor and six brakemen; night engines conductor and five brakemen. The switching movement to and from train shed, receiving yard, express yard and engine-house track is controlled by an electric pneumatic interlocking plant, consisting of 70 levers handled by three directors and six levermen on a shift of eight hours.

All eastward trains are scheduled to boats at Hoboken showing arrival at New York. In rush hours we have some cases where three trains are scheduled to a boat. The total number of eastward trains in suburban service is 104 in 24 hours, requiring 925 coaches averaging 45 passengers per car during the hours mentioned. From 8 a. m. to 9 a. m. 17 trains arrive, an average of 55 people per coach, or about 10,000 people in the hour. Trains being scheduled to boats, it is necessary that they should arrive at Hoboken on time, giving the passengers sufficient time to move from trains to boats and enable the latter to maintain their schedule. This necessitates the clearing of the receiving tracks very rapidly. All suburban trains carry baggage and the baggage goes on same boat as the passengers. It is the duty of the station master and assistant superintendent of ferries to see that trains make boats for which they are scheduled. This being so important conductors are required to know that their trains make the boats and report to trainmaster, who will immediately investigate if the schedule is not made.

Westward trains are scheduled from New York and Hoboken. Trains are held for boats. Train porters leave New York side with each boat, and are the last to leave the boats, delivering a ticket to assistant station master which indicates that the passengers have arrived for train for which they are scheduled. The conductor punches this ticket, acknowledging arrival of boat, then pushes indicator to main interlocking tower, notifying them that the train is ready to proceed. Switches and signals are then given for the movement of train, the director in the main tower passing the information to three other towers using a code of signals that indicates to the tower men at west end of tunnel whether train is going via main line or Morristown Branch.

The rush movement westward is between 5 and 6 p. m., requiring 17 trains, 121 coaches, moving 7,134 passengers, an average of 58 passengers per coach. These trains consist of seven to ten coaches each. A total of 106 passenger trains west in 24 hours is required for the suburban movement. We have, in some instances, three and four trains scheduled from one boat; consequently, if first train does not leave on time the two or three following trains are delayed, which affects the movement of following trains. This is due to boats being delayed by fog, weather conditions or barges or floats interfering with their movement.

In the entire movement of passenger trains is required the handling over the turn table of 288 engines for the 24 hours, the greater number being handled between 9 a. m. and 3 and 4 p. m., averaging at that time an engine on table every three minutes.

The freight terminal consists of Hoboken City freight station and team tracks located north of the passenger main tracks west of passenger yard, where local business is handled to and from Hoboken and steamship docks located at this point. Hoboken terminal station is located south of the canal. We have an open pier, storage tracks, three covered piers, a canal 3,000 ft. long where lumber and other rough freight is handled direct to boats and to cars, three float bridges, two coal dumps all located south of canal. From 1,400 to 1,600 cars, freight and coal are handled daily between passenger trains in and out of Hoboken, requiring a freight train movement of 85 to 95 trains. From 6 a. m. to 10 a. m. and 2.30 p. m. to 6.50 p. m. nothing but manifest trains can be moved in and out of freight yard. The switching required for placing cars on team tracks, open docks, covered piers, coal docks, grain trestle, float bridges, etc., show an average of five movements to each car, or 200,000 movements for 40,000 cars handled.

Because of closed hours it leaves but 16 hours for the movement of freight and manifest trains. The latter must leave the yard on schedule or serious delay will follow.

All orders for the placing of freight are given by the agents on a regular switching form to be placed in the hands of the yardmaster not later than 6 p. m., and call for the special delivery of from 800 to 1,000 cars to be placed in position for unloading by 7 a. m. This includes orders issued for cars to be delivered to floats, etc.

Movements in and out of Hoboken, freight and passenger, are governed by the tunnel. Trains are operated through tunnel under control of slotted semaphore signals, they being controlled by track circuit, and trains moved only on clear block. The train movement through tunnel, including passenger, freight and transfer engines, shows an average movement of every 13½ minutes east, and 12½ minutes west during the 24 hours. From 7.30 to 9.30 a. m. eastward movement averages a train every 3½ minutes and from 4.30 p. m. to 6.30 p. m. westward every four minutes.

REPORT ON RAIL SECTIONS OF THE SPECIAL COMMITTEE OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.*

Your special committee on rails respectfully report that the instructions under which they were appointed in 1902 are: (1) To report upon the results obtained in the use of rails of the sections presented to the society in annual convention, Aug. 2, 1893, by a special committee appointed for that purpose; (2) To report whether any modification of any of said sections is advisable, and, if so, to recommend such modification; (3) To report upon the recognized practice as to chemical composition and mechanical treatment used in the manufacture of rails, and the manner of inspection of the same; (4) To report upon the advisability of the establishment of a form of specification covering the manufacture and inspection of rails; (5) If found advisable, to recommend a form of specification for the manufacture and inspection of rails.

Since their appointment they have held as many meetings as the progress of their work seemed to require; in addition to which, and, in fact, in pursuance of the action of the committee at those meetings, extensive correspondence has been carried on by the officers of the committee with the officials of the principal railroads of the United States, Canada and Mexico. There has also been correspondence with the officers of the rail committee of the American Railway Engineering and Maintenance of Way Association, and one joint meeting held with that committee. There have also been two meetings with a committee representing the steel rail manufacturers of the United States. Your committee would now report:

RESULTS OBTAINED IN THE USE OF THE PRESENT SECTIONS.—During this year reports have been received from 79 of the leading railroads of the United States, Canada and Mexico. Of these, 13 roads had no criticism to make for or against the American Society sections; 23 roads say they are entirely satisfactory; 2 say emphatically they are good standards; 14 roads criticised the shape of head; 2 roads criticised the web; 2 roads say it ought to have a broader base; some other criticisms refer to the vertical sides, which, they claim, wear the wheel flanges, and some other slight changes in shape are suggested. In addition, 48 railroads reported that the society's sections were their standard; 10 railroads reported that they did not use them; 19 railroads have used them partially as standard; 3 railroads have used them, but do not now; 63 railroads say positively they intend to use them as standard; 14 say they will not do so; 2 say they will probably use them.

MODIFICATION OF SECTIONS.—What are popularly known as the rail sections of this society were recommended by a special committee, in 1893. For the year ending June 30, 1905, the following percentage of their total output was rolled by eight mills in the United States for domestic and export uses:

	Domestic.	Foreign.
Pennsylvania Steel Co. ..... Maryland Steel Co.	82%	Practically none.
Cambria Steel Co.	77%	None.
Illinois Steel Co.	84%	None.
Carnegie Steel Co.	69.34%	78.9%
Lackawanna Steel Co.	99.3%	Practically none.
Tennessee Coal & Iron Co. ...	88.6%	None.
Colorado Fuel & Iron Co.	65%	None.

Since 1893 the speed of trains and wheel loads have been increased proportionately very much more than the weight of rails. The increase in driving-wheel loads is approximately 60%, while the maximum weight of rails has increased from 80 to 100 lbs., or 25%. Rails of the heavier sections are not giving the service expected of them, even after making due allowance for the increased traffic tonnage or for the trouble caused by badly balanced driving wheels, and poor condition of rolling stock and roadbed, but, after due consideration of all the information collected, your committee does not feel justified in now recommending any modifications of the sections.

RECOGNIZED PRACTICE AS TO CHEMICAL COMPOSITION AND MECHANICAL TREATMENT.—In relation to the chemical composition of rails made by the acid Bessemer process, the general practice in the United States is to accept what are known as the manufacturers' standard specifications. These are:

	70 lbs. up to 80 lbs. Per cent.	80 lbs. up to 90 lbs. Per cent.	90 lbs. up to 100 lbs. Per cent.
Carbon	0.45 to 0.55	0.48 to 0.58	0.50 to 0.60
Phosphorus, not over.	0.10	0.10	0.10
Silicon, not over	0.20	0.20	0.20
Manganese	0.75 to 1.00	0.80 to 1.10	0.80 to 1.10

*Report presented at the annual meeting of the American Society of Civil Engineers, held Jan. 17, 1906, at New York City.

Previous to Dec. 10, 1904, the carbon percentages were five points lower, the other elements being amounts as now. Some railroads have insisted and obtained modifications by which the carbon percentages have been increased and the phosphorus kept not to exceed 0.085%. In a few instances, phosphorus has been held lower, but such rails are now made only from a large admixture of imported ores. Some of the Canadian roads have been able to obtain from the United States rail-makers, 80-lb. American Society section rails, with the following actual composition:

	Per cent.
Carbon	0.58 to 0.64, average 0.60
Phosphorus	0.059 to 0.071
Silicon	0.125 to 0.165
Sulphur	0.049 to 0.056
Manganese	0.93 to 0.96

The Bessemer rails, which the same parties are having manufactured in Canada, contain:

	Per cent.
Carbon	0.53 to 0.63, average 0.58
Phosphorus, not to exceed	0.085
Silicon	0.075 to 0.15
Sulphur, not to exceed	0.075
Manganese	0.80 to 1.10

Up to the present time it has not been proven that the basic Bessemer process of rail-making is commercially practicable with American iron ores. The basic open-hearth process has reached enormous development in the United States, but only one plant is regularly putting its steel into rails. Their standard specifications are:

	70 lbs. up to 80 lbs. Per cent.	80 lbs. up to 90 lbs. Per cent.	90 lbs. up to 100 lbs. Per cent.
Carbon	0.50 to 0.60	0.55 to 0.65	0.58 to 0.68
Phosphorus, not over.	0.06	0.06	0.06
Silicon, not over	0.20	0.20	0.20
Manganese	0.75 to 1.05	0.80 to 1.10	0.80 to 1.10

There is also a basic open-hearth rail mill in Canada.

The mechanical treatment of the metal differs somewhat in the practice of the largest American rail producers. At three mills the bloom is reheated after leaving the blooming rolls, and before entering the rail rolls. At the others, the rolling process is a continuous one, from the time the ingots are drawn from the heating furnaces. All but two of the mills have three-high trains of rail rolls. During several years, all the mills have been crowded with work, and the tendency has been to use every exertion to increase production. In your committee's opinion, this has led to rolling the steel at too rapid a reduction and at too high a temperature, and to other details which largely account for the unsatisfactory service given by the heavy-sectioned rails.

Practically all large purchasers of rails have them inspected at the mills either by men detailed from their own organization or by professional inspectors. Such inspection covers seeing that the provisions of the specifications under which the rails have been purchased are observed; particularly checking the accuracy of section, squareness and length of sawing, accuracy of drilling, straightness in line and surface, and freedom from mechanical defects.

THE ADVISABILITY OF THE ESTABLISHMENT OF A FORM OF SPECIFICATION.—In this country rails are made by two processes—acid Bessemer and basic open hearth, the former process covering quite 90% of the production. On the continent of Europe nearly all rails are made by the basic Bessemer, and in England, with the exception of one works, all commercial rails are made by the acid Bessemer process, the difference in the practice of the several countries being occasioned by the character of their available iron ores. The same controlling influence must be recognized in preparing chemical and other specifications for the manufacture of rails in this country. Your committee believe that a low percentage of phosphorus and high percentage of carbon make a better rail steel than when the amount of the former element necessitates the curtailment of the latter. When rails of lighter sections were used, chemical conditions were not so important as with the heavier ones; this because the rolling down of the steel to the smaller sections of necessity gave it more work, and also finished the rail at a lower temperature, thus producing a finer-grained and tougher metal. This partially explains why so many of the early steel rails gave good physical results, while their chemical composition was so irregular.

Taking everything into consideration, your committee think it advisable to present specifications covering the manufacture and inspection of rails, but realize that restraining commercial ore conditions keep them from being ideal ones, chemically; and existing manufacturing plants and practice limit what can be specified for the physical treatment of the steel; but, believing, as your committee do, that the physical treatment is of as great importance as its chemical composition, they do recommend certain requirements which should be enforced. These will tend toward the production of better wearing rails, and also safer ones. Your committee recognize that commercial conditions cannot be entirely disregarded by engineers, but, at the same time, they believe that when it is known that existing practice results in danger to human life and limb, it becomes the duty of the engineer to insist on their being changed, even though that necessitates either a greater cost to the consumer

or a somewhat less profit to the producer. That point will adjust itself, but the safer practice should be demanded. This view controlled your committee in framing the clause of these recommended specifications governing the shearing of the rail blooms, as it is well known that one of the frequent causes of failure of steel rails is due to piping, and that this comes from unsound ingots. Unfortunately, such failures often cause accidents which result in large material damage, and, what is worse, the loss of life. Frequently, such interior defects cannot be detected until after the rails have been subjected to traffic, hence it is of the greatest importance that care should be exercised in the manufacture, with a view of reducing the danger to a minimum.

Your committee have studied the results obtained from basic open-heart steel rails, and, while their use has not extended over many years, at the same time, the evidences point to their giving better service than the Bessemer rails. This is strikingly demonstrated by certain experimental very high carbon ones laid on the lines of the Pennsylvania Railroad. It must be understood that the physical differences of the two steels are not entirely due to their chemical composition; as it is a well-known metallurgical fact that steel made by the basic open-hearth process possesses characteristics of its own.

They have prepared specifications for both Bessemer and basic open-hearth rails. While the majority of the rail plants of the country are not now adapted to the making of basic open-hearth rails, the greater known amount of the iron ore supply is suitable, hence the production of that kind of steel rails will increase.

RECOMMENDED SPECIFICATIONS FOR BESSEMER STEEL RAILS.

PROCESS OF MANUFACTURE.—The entire process of manufacture and testing shall be in accordance with the best state of the art, and the following instructions shall be faithfully executed:

Ingots shall be kept in a vertical position in the pit heating furnaces until ready to be rolled, or until the metal in the interior has had time to solidify. No bled ingots shall be used.

There shall be sheared from the end of the blooms formed from the top of the ingots, assuming that such blooms are about 8 by 8 ins. square, at least 40 ins., and, if from any cause, the steel does not then appear to be solid, the shearing shall continue until it does. If by the use of any improvements in the process of making ingots, the defect known as piping shall be prevented, the above shearing requirements may be modified.

The number of passes and speed of train shall be so regulated that, on leaving the rolls at the final pass, the temperature of the rail will not exceed that which requires a shrinkage allowance at the hot saws, for a 33-ft. rail of 100-lb. section, of $6^{7}/_{16}$ in., and $^{1}/_{16}$ in. less for each 5-lb. decrease of section. These allowances to be decreased at the rate of $^{1}/_{80}$ in. for each section of time elapsed between the rail leaving the finishing rolls and being sawn. No artificial means of cooling the steel shall be used after the rails leave the rolls, nor shall they be held before sawing for the purpose of reducing their temperature.

CHEMICAL COMPOSITION.—Rails of the various weights per yard specified below shall conform to the following limits in chemical composition:

	70 to 79 lbs. Per cent.	80 to 89 lbs. Per cent.	90 to 100 lbs. Per cent.
Carbon	0.50 to 0.60	0.53 to 0.63	0.55 to 0.65
Phosphorus shall not exceed	0.085	0.085	0.085
Silicon shall not exceed	0.20	0.20	0.20
Sulphur shall not exceed	0.075	0.075	0.075
Manganese	0.75 to 1.00	0.80 to 1.05	0.80 to 1.05

DROP TEST.—One drop test shall be made on a piece of rail not less than 4 ft. and not more than 6 ft. long, selected from each blow of steel. The test piece shall be taken from the top of the ingot. The rails shall be placed head upward on the supports, and the various sections shall be subjected to the following impact tests under a free falling weight:

70 to 79-lb. rails	18 ft.
80 to 89-lb. rails	20 "
90 to 100-lb. rails	22 "

If any rail breaks, when subjected to the drop test, two additional tests may be made of other rails from the same blow of steel, also taken from the top of the ingots, and if either of these latter rails fail, all the rails of the blow which they represent will be rejected, but if both of these additional test pieces meet the requirements, all the rails of the blow which they represent will be accepted.

The drop-testing machine shall have a tup of 2,000 lb. weight, the striking face of which shall have a radius of not more than 5 in., and the test rail shall be placed head upward on solid supports 3 ft. apart. The anvil block shall weigh at least 20,000 lbs., and the supports shall be part of, or firmly secured to, the anvil. The report of the drop test shall state the atmospheric temperature at the time the test was made.

SECTION.—Unless otherwise specified, the section of rail shall be the American standard, recommended by the American Society of Civil Engineers, and shall conform, as accurately as possible, to the templet furnished by the railroad company, consistent with the paragraph relative to specified weight. A variation in height of $^{1}/_{64}$ in. less, or $^{1}/_{32}$ in. greater than the specified height, and $^{1}/_{16}$ in. in width will be permitted. The section of rail shall conform to the finishing dimensions.

WEIGHT.—The weight of the rails will be maintained as nearly as possible, after complying with the preceding paragraph, to that specified in contract. A variation of $^{1}/_{2}$ of 1% for an entire order will be allowed. Rails will be accepted and paid for according to actual weights.

LENGTH.—The standard length of rails shall be 33 ft. Ten per cent. of the entire order will be accepted in shorter lengths, varying by even feet to 27 ft., and all No. 1 rails less than 33 ft. long shall be painted green on the ends. A variation of ¼ in. in length from that specified will be allowed.

DRILLING.—Circular holes for splice-bars shall be drilled in accordance with the specifications of the purchaser. The holes shall conform accurately to the drawing and dimensions furnished, in every respect, and must be free from burrs.

STRAIGHTENING.—Care must be taken in hot-straightening the rails, and it must result in their being left in such a condition that they shall not vary throughout their entire length more than 5 ins. from a straight line in any direction, when delivered to the cold-straightening presses. Those which vary beyond that amount, or have short kinks, shall be classed as second quality rails and so stamped.

Rails shall be straight in line and surface when finished—the straightening being done while cold—smooth on head, sawed square at ends, variation to be not more than $^{1}/_{32}$ in., and, prior to shipment, shall have the burr occasioned by the saw cutting removed, and the ends made clean. No. 1 rails shall be free from injurious defects and flaws of all kinds.

No. 2 rails shall be accepted up to 5% of the whole order. They shall not have flaws in their heads of more than ¼ in., or in the flange of more than ½ in. in depth, and, in the judgment of the inspector, these shall not be so numerous or of a character as to render them unfit for recognized second-quality rail uses. The ends of No. 2 rails shall be painted white, and shall have two prick-punch marks on the side of the web near the heat number brand, and placed so as not to be covered by the splice-bars. Rails from heats which failed under the drop test shall not be accepted as No. 2 rails.

BRANDING.—The name of the maker, the weight of the rail, and the month and year of manufacture shall be rolled in raised letters on the side of the web; and the number of the blow shall be plainly stamped on each rail where it will not subsequently be covered by the splice-bars.

INSPECTION.—The inspector representing the purchaser shall have free entry to the works of the manufacturer at all times when the contract is being filled, and shall have all reasonable facilities afforded him by the manufacturer to satisfy him that the finished material is furnished in accordance with the terms of these specifications. All tests and inspection shall be made at the place of manufacture prior to shipment.

The manufacturer shall furnish the inspector, daily, with carbon determinations for each blow, and a complete chemical analysis every 24 hours, representing the average of the other elements contained in the steel, for each day and night turn. These analyses shall be made on drillings taken from small test ingots.

FOR BASIC OPEN-HEARTH RAILS.—The specifications for rails made by the basic open-hearth process shall be the same as for Bessemer rails, excepting that their chemical composition shall be:

	70 to 79 lbs. Per cent.	80 to 89 lbs. Per cent.	90 to 100 lbs. Per cent.
Carbon	0.53 to 0.63	0.58 to 0.68	0.65 to 0.75
Phosphorus shall not exceed	0.05	0.05	0.05
Silicon shall not exceed	0.20	0.20	0.20
Sulphur shall not exceed	0.06	0.06	0.06
Manganese	0.75 to 1.00	0.80 to 1.05	0.80 to 1.05

We respectfully submit the above report and request the discharge of your committee.

JOSEPH T. RICHARDS, Chairman;
C. W. BUCHHOLZ,
E. C. CARTER,
S. M. FELTON,
RICHARD MONTFORT,
H. G. PROUT,
EDMUND K. TURNER,
ROBERT W. HUNT, Secretary.

The undersigned concurs in the foregoing report with the exception of the clause relating to the continuance of the present sections.

JOHN D. ISAACS.

Mr. George E. Thackray, upon consideration following the meeting at which the majority report was prepared, decided that he did not feel justified in signing that report, neither did he feel like making a minority report, and, therefore, thought it wise that the report be withheld for further consideration.

ROBERT W. HUNT,
Secretary Special Rail Committee.

MINORITY REPORTS.

In the report and specification of your special committee on rails some points are conflicting and should be further discussed before a final report is made. It is therefore suggested that the present report be considered a report of progress, and presented to the society for discussion at the annual convention in June, 1906.

The report makes a strong plea for lower temperatures in rolling in order to secure better metal in the rails, and every effort should be made to accomplish this without making too radical changes in the methods of manufacture. The high carbons called for in the specification are contrary to this idea, and are more in line with the practice of relying on the chemical composition alone to give hardness in the rails. There is no trouble in getting hardness in this way, but the rails are likely to be brittle, and thus increase the number of breakages. The large number of rails, irrespective of section and weight, which are now breaking in service, cannot be ignored, and, if necessary, it would be better to stand some additional wear, if rails could be secured which would not break.

In all T-rails the thin flanges control the finishing temperature, and, in order to get a rail which could be rolled at a lower temperature, it has been suggested to add more metal to the bottom of the flange of the present Am. Soc. C. E. section in order to allow a lower finishing temperature in rolling and retain the advantages of the present wide head for bearing surface and side wear. This would not prevent the metal in the head from breaking off in the plane of the web, as at present. This breakage occurs in all weights of rails, and is generally due to piped steel or segregation.

In order to prevent the heads from breaking, it has been suggested to use one standard width of head for rails of 80 lbs. and more, increasing the thickness of the head and of the flange as the weight increases, thus producing a stiffer rail in the heavier sections, with a head better suited to withstand the severe effect of worn wheels riding the edge of the head. Rails of 85 to 100 lbs. of such sections could be finished at the same temperature in rolling, and therefore be made of the same carbon steel.

Notwithstanding the advantages which might be derived from such rails, it would be ill-advised to recommend any change of section until every means has been exhausted for producing better steel, on account of the large commercial interests involving both the manufacturer and consumer.

WM. R. WEBSTER.

While concurring in the major portion of the conclusions arrived at by the majority of your special committee on rails, the undersigned deems it his duty to present a minority report.

Instruction No. 1.—He agrees with the majority report.

Instruction No. 2.—He agrees with the majority report, with the following addition: The attention of the society is called to the fact that certain failures in service, especially of rails of maximum sections, can be traced to the uneven temperatures of the various parts of the sections when finished at the rolls due to the large cross-section of head and relatively small areas of flange and web. This very dangerous defect can alone be remedied by a very radical change of design which your committee, with the data now at their command, do not feel authorized in recommending, but believe that the attention of the society should be called to the matter as a subject for future investigation and report.

Instruction No. 3.—He agrees with the majority report.

Instruction No. 4.—He dissents from the conclusion of the majority report. He is of the opinion that specifications as prepared by the user should extend only to the quality of the finished material both chemically and physically, the details and methods of manufacture being left entirely to the producer, but that the requirements be made so rigid that only material made in accordance with the best state of the art will fill the specifications. He dissents from the opinion:

When the rails of lighter sections were used, chemical conditions were not so important as with the heavier ones; this because the rolling down of the steel to the smaller sections of necessity gave it more work, and also finished the rail at a lower temperature, thus producing a finer-grained and tougher metal. This partially explains why so many of the early steel rails gave good physical results, while their chemical composition was so irregular;

but believes that chemical composition was as important in the past as it is in the present, and equally so in all sections; the variations referred to can be accounted for by physical conditions rather than chemical composition.

As to other statements of the majority report under this clause he agrees.

Instruction No. 5.—He dissents from the clauses of the proposed specifications relating to methods of manufacture, and would omit the same. He agrees with those relating to quality and requirements of finished material, excepting as to carbon and manganese content. He would also propose the addition of a test for tensile strength and elongation, the test piece to be cut from the head of the rail, and would add to the drop test a measure of limiting deflection.

He would also call attention to the following point: If a discard be required, it should be measured by a certain percentage of the ingot, and not by the length of the bloom.

The proposed method of regulating the finishing temperature will not necessarily accomplish the desired result, as the rail may be held prior to entering the finishing pass or at some other point until the proper finishing temperature be attained, while what is sought to be accomplished is that the ingot be worked throughout at a lower temperature than prevails in present practice.

He sees no reason why the carbon and manganese content, as specified for light sections, should be raised as the weight of the rails is increased, for the reason that the heavier the rail the more uneven the temperatue at finishing throughout the various portions of the section, and the higher the carbon the more susceptible the steel to heat treatment, the heavier the rail the higher the temperature of the head at finishing; while, conversely, the higher the carbon the lower the working temperature should become. As long as we continue our present practice of using sections of such varing cross-sections as we have in our maximum weights, a high content of metalloids will always be a menace to successful service, which is not alone measured by wear of individual rails, but also by uniformity of results and freedom from sudden breakage.

His individual opinion is in favor of even a lower carbon content than proposed in the majority report, coupled with such physical requirements of finished material as will necessitate a rolling of the material at a lower temperature than now practiced. Respectfully submitted,

PERCIVAL ROBERTS, Jr.

CAR CONSTRUCTION AND COST RECORDS: CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

While many large railway systems build a certain proportion of their freight cars, the Chicago, Milwaukee & St. Paul Ry. is notable for its policy of building all its freight equipment at its own shops. This policy is followed for the reason that the experience of several years shows that the system ensures a lower cost than can be quoted by contract shops. In order to maintain the low cost and high efficiency, and to show the actual economy to the executive officers (as when car-building firms desire to compete for orders for new cars) very careful cost records must be kept, not only for each order but for the work as a whole. The system of records was worked out and adopted in 1888 by Mr. J. J. Hennessey, Master Car Builder, and we are indebted to him for an opportunity to examine it during a recent visit to the company's main shops at West Milwaukee, Wis. All of the new construction and most of the repair work is done at these shops, but a portion of the repair work is done at the division shops at Dubuque, Ia., and Minneapolis, Minn. Both locomotive and car departments are under the general direction of Mr. A. E. Manchester, Superintendent of Motive Power.

The freight equipment of this company amounts to about 43,000 cars. The building of new cars at the West Milwaukee shops was begun in 1888, and since that time they have turned out 28,092 cars, as follows:

Freight cars	27,663
Caboose cars	227
Pile drivers	7
Slope levelers	4
Lidgerwood unloader machine cars	5
Baggage cars	75
Mail cars	65
Combination cars	31
Milk cars	10
Electric light and heat tenders	2

CAR DEPARTMENT.—This department at the West Milwaukee shops is well organized and equipped, and employs about 1,800 men regularly. It has seven main buildings, besides smaller auxiliary buildings; while light freight car repairs are made in a repair yard of 16 tracks (four of which are supply tracks); all the tracks are spaced 15 ft. c. to c., and the yard has a capacity for 200 cars. The first five buildings (noted below) are parallel with one another, forming a complete group; between the erecting and painting shops is a transfer table pit, which also extends to the repair tracks and back to the end of the woodworking shop, so that the transfer table serves the three shops as well as the repair yard. The shop for upholstery and light work and also paint storage is a new building, and on the upper floor of this the Master Car Builder has his office. The coach painting shop has also been extended 204 ft., making its total length 607 ft., while the width of the new portion is 103 ft., or 10 ft. wider than the older portion, on account of the increased length of passenger cars. In this shop Mr. Hennessey has introduced painters' platforms of his own design. The platforms slide on vertical posts, being balanced so as to be easily moved, while automatic catches engage slots 6 ins. apart, so that there is no danger of platforms dropping, through the men failing to properly secure them. The blacksmith and machine shops also have tools and appliances of special design. All new buildings are of steel and brick, and the paint mixing building has concrete floors. The construction is done by the company's Bridge and Building Department, instead of by contract. The main buildings are as follows:

		ft.
1.	Passenger car erecting shop	93 × 403 103 × 204
2.	Passenger car painting shop	93 × 403 103 × 204
3.	Paint store and upholstery shop	93 × 587
4.	Blacksmith and machine shop	80 × 559
5.	Freight car erecting shop	103 × 624
6	Woodworking shop	83 × 404
7.	Planing mill	72 × 110

FREIGHT CAR DETAILS.—A special feature of the freight car construction on this road is that all new cars are equipped with the Hennessey steel center-sill construction, which consists of a pair of steel channels with the draft and coupler attachments fitted between them, so that all buffing and pulling stresses are taken directly by the sills. The steel body bolster has the top (horizontal) bar passed through slots in the neutral axis of the webs of the channel sills, while the bottom flanges of these sills have a bearing of about 24 ins. in length on a malleable-iron center casting fitted between the upper and lower bars of the bolster. Malleable-iron spacing blocks are fitted between all the sills, and the sills, center castings and bolsters are strongly riveted and bolted together to form one member. The center plate is attached to the lower bar of the bolster, and takes the load direct from the sills through the center castings. All of the new cars are also fitted with the Hennessey double-spring friction draft gear. Most of the freight cars built have the side-bearings of the trucks fitted with the Barber side-motion rollers; these are found to be thoroughly serviceable, the rollers remaining true and showing no tendency to flatten.

		500—40-ton capacity 40-ft. Wooden Box cars. Shop Order No. 663.	
Large wood-working mill	Body	$.....	$.....
	Trucks	.....	.....
Small wood-working mill	Body	.....	.....
	Trucks	.....	.....
Blacksmith shop	Body	.....	.....
	Trucks	.....	.....
Iron machine shop	Body	.....	.....
	Trucks	.....	.....
Erecting shop	Body	.....	.....
	Trucks	.....	.....
Tinners	Body	.....	.....
Door makers	Body	.....	.....
Painters	Body	.....	.....
	Trucks	.....	.....
Handling and distributing material through shop	Body	.....	.....
	Trucks	.....	.....
Handling and distributing lumber in lumber yard	Body	.....	.....
	Trucks	.....	.....
Iron foundry	Body	.....	.....
	Trucks	.....	.....
Brass foundry	Trucks	.....	.....
Total cost of body, plus 5%*		.....	.....
Total cost of trucks, plus 5%*		.....	.....
Grand total cost of body and trucks		.....	.....
Commenced		.....	.....
Finished		.....	.....

* For cost of supervision.

Fig. 1. Record of Labor Cost on Freight Car Construction; Chicago, Milwaukee & St. Paul Ry.

FREIGHT CAR CONSTRUCTION RECORDS.—The necessity for close economy and accurate records of cost in the work of building freight cars has already been explained. The records are kept in two large books with pages of section-paper appropriately ruled, and these two books contain the records of cost of every lot of cars built since 1888. Certain groups of pages are allotted to cars of different kinds, so that the records for box, flat, gondola, furniture and other cars are all grouped together. Fig. 1 shows the left hand page of the first book, in which the cost of labor for each order is distributed through the several departments.

The page is 18 × 13½ ins., and contains 13 columns for costs; the opposite page has 24 similar columns (¾-in. wide), the one column of departments at the left serving for both pages. Thus each double page can contain the records of cost for 34 shop orders, so that the records are very compact and readily followed. In every case the items are reduced to cost per car, so that they are comparable for the several orders, while the heading of the column shows the number of the shop order and the number and type of cars ordered. To the actual cost for labor a suitable percentage is added to cover the cost of supervision. The costs of body and trucks are kept separate, as the former will vary considerably, according to whether the trucks are purchased complete or are built at the shops; in the latter case the use of special bolsters purchased from manufacturers will also reduce the shop cost.

If the cost in the woodworking shop (for example) should be shown to be materially higher for one lot of box cars than for another lot of similar cars, the shop foreman will be called upon for an explanation. All the shop foremen, therefore, have an incentive not only to try to keep the cost down, but also to keep accurate records to prove their case. The figures in the books are compiled from the foreman's slips, which are first compared with the timekeepers' slips to check any mistakes, the timekeepers being under the jurisdiction of the General Storekeeper. This record is for labor only, as the shops have no control over the market price of materials, and the Master Car Builder has

G. S. D. 8.

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

STORE DEPARTMENT.

STATEMENT of Cost of Repairing.....Car No.....at.....Shop.

In Shop.....190... Out of Shop.....190..

	LABOR	MATERIAL	TOTAL
Cabinet Maker,			
Carpenter,			
Carsmiths,			
Tinsmith,			
Upholsterer,			
Machinist,			
Blacksmith,			
Painter,			
Wood Working, Machine Hands,			
Silver Platers,			
Steam Fitters,			
Electric Light Work,			
Glazing,			
CORRECT:	5% added to labor,		
	TOTAL COST,		

FIG. 3. RECORD OF COST OF PASSENGER CAR REPAIRS; CHICAGO, MILWAUKEE & ST. PAUL RY.

tion. It is conveyed to bodies of salt water, such as tidal streams or bays or other arms of the sea. This method of disposal in a majority of instances, when well carried out, has been found to be reasonably satisfactory from the standpoint of avoiding general nuisances. It is capable of being better applied in many instances, not only along the Massachusetts seacoast, but also along the entire Atlantic coast. One of the least satisfactory features in the disposal of sewage by dilution is that the sewage is not brought quickly enough to the deep water where adequate currents exist to disperse the sewage. There is a tendency in many places to allow the outfall sewers to stop on the flats exposed at low tide, or in shallow water, rather than to convey the sewage to deep water where the outlets are suitably located and submerged at all times. The method of disposal by dilution has, of course, a different phase when it involves the pollution of shellfish, which makes it a proposition requiring special consideration. This method of disposal is not such a barbarous practice from the standpoint of eliminating nuisances as one might imagine, when compared with the disposal of garbage and with the ventilation of public and private dwellings.

In the disposal of sewage by dilution it is necessary, as already stated, to see that the sewage is thoroughly and quickly dispersed throughout the body of water in which it is diluted. It is probable that the portion of New York City on Manhattan Island is the best located city in the world for the disposal of sewage by dilution. That does not mean necessarily that it is perfect, but by extending the sewers out to or beyond the pier lines and having the sewage discharged well beneath the surface of the water, after screening from it all coarse, solid particles, there results a method of disposal probably unsurpassed, both in regard to cheapness and to lack of offensiveness.

Where the question of shellfish is not a factor, dilution will no doubt continue for many years to be the most prevalent method of disposal. It is obvious from available evidence that there is much room for improvement at present, and that current practice will be much modified. With the removal of suspended particles of visible size, there are still left for consideration in large projects the questions of odors and of sleek, which is the thin film of grease upon the surface of the water in the vicinity of the outfall. As the volume of sewage discharged at a single point increases the importance of these factors also increases. How much sewage can be discharged through a single outfall is still a more or less debatable question. At the Deer Island outlet in Boston harbor about 50,000,000 gallons of sewage are discharged daily. Odors are rarely, if ever, noticed at a greater distance than one-quarter of a mile, which is generally stated as the limit to which odors can be detected in the neighborhood of large modern purification works in Europe. The sleek on the surface of the water in calm weather can be seen for a mile or so. Means for the removal of the grease producing this sleek and for aerating the sewage to reduce odors where these factors are objected to are fruitful fields of investigation. Their accomplishment will no doubt be very much less expensive than that for complete purification.

Where shellfish are found in seacoast waters the sewage of neighboring cities should be disposed of according to the relative financial importance of the shellfish industry and of the purification of the sewage. Where the oysters and clams represent relatively small sums of money, then purification works will presumably not be built; the shellfish will be eliminated and the sewage disposed of by dilution. Where the shellfish industry is large and the necessary sewage works comparatively small and inexpensive, the logical thing to do is to purify the sewage thoroughly in artificial works along the lines required of inland cities where the quality of neighboring water supplies is a factor. There is also, of course, an intermediate class where local conditions must be most carefully studied before deciding between the shellfish and purification works.

PREPARATORY METHODS: SEDIMENTATION, SEPTIC TREATMENT, CHEMICAL PRECIPITATION.

There are various styles of works for the artificial treatment of sewage. The first of these methods which I will mention is sedimentation, which consists simply in allowing the sewage to flow through shallow reservoirs, holding ordinarily from two to twelve hours' flow. In these basins are deposited from 50% to 70% of the coarser suspended matters, and about the same per cent. of bacteria. Sewage purification by sedimentation is perhaps a misleading statement, for it is not purification in the full sense of the word. It is more properly clarification, in which there is a removal of some of the sludge or suspended matter. This is a reasonable thing to do, as it reduces clogging of the filter in which the sewage is finally purified.

The last few years have brought to the front the correct idea that sedimentation and allied methods are really preparatory treatments, and that they do not constitute by themselves a full purification process. Sedimentation is very similar to chemical precipitation, which is practiced in a few places in this country and in many European places, except that efficient works of the latter type reduce the suspended matter and bacteria 80% to 90%. Septic treatment, so called, is nothing more or less than plain sedimentation, to which is added the practice of not removing sludge, but allowing the latter to remain for a long time on the bottom of the reservoir holding at least eight hours' flow, and to rot there. The rotting is nothing more than putrefaction by bacterial agencies. This putrefaction causes, on an average, about one-half of the total matter deposited from the sewage to become liquefied and gasified. In that way the septic tank is a helpful preparatory step, as it puts the sewage in shape to be treated by some method of filtration more advantageously and reduces the cost of sludge disposal.

The total organic matters in sewage are reduced about one-third by sedimentation and by the septic treatment, and about one-half by chemical precipitation. Effluents of all of these treatments are putrescible, and, as above stated, require subsequent filtration ordinarily, although there are cases, apparently, where any one of these preparatory treatments may suffice for the present in eliminating nuisances.

INTERMITTENT FILTRATION THROUGH SAND.

Intermittent filtration through sand is well known to you through the Lawrence investigations and the 15 to 20 plants where this method is practiced in New England. Coarse-grain filters have been developed largely in England, although they have been studied carefully at Lawrence and elsewhere in this country, and also in Germany. These filters, known as contact filters, or sprinkling filters [also called contact beds, or percolating filters.—Ed.] according to the method of operation, have made a marked advance in matters of sewage purification, especially for cities not having near at hand suitable areas of porous sand.

For cities of small or moderate size, where medium or coarse sand is readily found, the best method of purification is ordinarily intermittent sand filtration, where an effluent of high bacterial purity is necessary or desirable. Where the filters are not overcrowded, the resulting effluents are practically clear, odorless, and contain only about 1% of the applied bacteria. The organic matter in the sewage is reduced much below that necessary to secure a non-putrescible effluent. One acre of land disposes of the sewage of from 500 to 1,000 persons, depending upon the porosity of the sand, care of filters, preliminary treatment of sewage, etc. Higher rates can be used, but it means more care and expense in keeping the filter surface free from clogging for winter work. Experience has shown that intermittent sand filtration is much more expensive than was thought to be the case some years ago. In fact, the experience of the last ten years in Massachusetts (see 1903 report of State Board of Health) with sand filters shows that the cost of these filters approximate, on an average, about 43 cts. per capita per annum, divided about equally between capital charges (5% per annum) and maintenance. This cost has nothing whatever to do with the collection system of sewers in the city, nor with the conveyance or pumping of the sewage to the disposal works. It is solely for the purification of the sewage.

COARSE GRAIN OR RAPID FILTERS.

Where an effluent of high bacterial purity is not necessary, coarse grain filters give adequate results, so far as a non-putrescible effluent is concerned. These filters are cheaper than intermittent sand filters where suitable sand is not readily available, and apparently in some cases also where such sand is found in the vicinity. The latter instances refer especially to conditions where the cost of delivery of sewage to intermittent filters much exceeds that for coarse grain filters.

One of the most important conclusions to which one is led by recent evidence from this country and abroad is that coarse grain filters have a field of usefulness where high bacterial efficiency is required. Contact filters, or sprinkling filters, are perfectly capable in connection with a suitable preparatory treatment to produce a non-putrescible effluent containing about 50 parts per million of suspended matter and about 10% of the bacteria in the raw sewage. Such a liquid is comparable with a turbid river water which is highly polluted with sewage. In other words, coarse grain filters reduce a sewage to a state where it can be subjected to the treatment applied for the purification of drinking water from turbid and polluted rivers. Mechanical filtration along the lines carefully worked out during the past ten years is perfectly capable of converting the effluent of coarse grain filters to a state of bacterial purity fully equal to that obtained by intermittent sand filters. This combined treatment is apparently cheaper than intermittent sand filtration for large projects, even where sand is fairly accessible. For small plants there is probably no economy. Where the dividing line comes in conditions favoring one or the other of these methods of purification can hardly be stated at present. It is a topic, however, upon which much will be said in future.

The application of copper sulphate or other germicides to the effluent of coarse grain filters is another way of securing a final product of high bacterial purity. It is probably more expensive and no more effective than a final filtration as above mentioned. For small plants it is nevertheless of value.

Preparatory treatment of the raw sewage to remove the sludge is highly desirable for nearly all large projects. For small ones it is not necessary where the sewage is treated by sand filters or sprinkling filters. Contact filters under all circumstances are operated to better advantage with a clarified sewage. Septic tanks are the best preparatory devices for ordinary conditions.

All of these remarks are directed to domestic sewage containing only small or moderate amounts of trade wastes. Large quantities of trade wastes increase the difficulty and expense of purification very materially. Trade wastes vary so in their character that each case requires special consideration, and there is very little to be said in general terms.

As to the capacity and best type of coarse grain filters, much evidence is available from abroad, where such filters have been operated on a practical scale for six or eight years. Valuable data have also been obtained in this country, both in practice and from test devices. The strength of sewage, climatic conditions, etc., are so different in America that foreign data are of less specific value for use in this country than are those obtained here. The city of Columbus, O., has in particular secured valuable data on recent methods of sewage purification, and data which are of value for application also along the seacoast. I will say a few words about Columbus results after making plain the differences between contact filters and sprinkling filters.

Coarse grain filters of all types should consist of firm material which will not disintegrate. Ordinarily the filters are 3 to 5 ft. thick—sometimes sprinkling filters are 8 ft. thick. All filters should be well underdrained. Contact filters are operated on the fill and draw plan. Sprinkling filters have the sewage applied to them in the form of a spray, either from revolving perforated pipes or from stationary pipes with nozzles. Contact filter material usually ranges in size from ⅛ in. to 1 in., and that for sprinkling filters from ½ in. to 2 ins.

THE COLUMBUS EXPERIMENTS.

The city of Columbus, O., voted two years ago to spend $1,200,000 in improving its sewerage systems, including purification works. To determine the best method of securing a non-putrescible effluent at least cost, it was decided to devote $46,000, or approximately the interest for one year, to a series of tests of the local sewage. The testing station was commenced a year and a half ago and was conducted for a period of one year. The results accomplished there are now in final shape, and are being printed in a public document, which will probably be available in a few months. These tests at Columbus show the results accomplished by more than 40 different devices in various combinations. The relative amounts of sludge, organic matter and bacteria which are removed by different methods of preliminary treatment were ascertained. They also furnish a large range of data as to the best rates, kinds and grades of material, etc., for filtration.

In brief, it was found that the best preparatory treatment was afforded by septic tanks holding an average flow of about eight hours. This caused a removal of about two-thirds of the bacteria and suspended matter in the sewage. About one-half of the deposited sludge is liquefied and gasified. No trouble with odors was encountered.

Sprinkling filters operated at an average rate of 2,000,000 gals. per acre daily form the next step in the process. It was found that winter weather, even in the severe climate of Columbus, did not seriously interfere with spraying the sewage on the filters. A non-putrescible effluent was obtained, containing about 10% of the original bacteria. Contact filters could produce an equal result when operated only at about one-fourth to one-third of the above stated rate for sprinkling filters. Further, there is less clogging in sprinkling filters than in contact filters, due to the suspended matter retained as films within the sprinkling filter cracking and peeling when the filter is rested (every other week). This removal of stored suspended matter is one of the chief characteristics of sprinkling filters. It makes the effluent somewhat unsightly in appearance, but this is readily corrected by passing the effluent through a small settling basin holding two or three hours' flow.

A 20,000,000-gallon plant of this type was recently put under contract at Columbus for $435,000, exclusive of land and of force mains and pumping station for delivering the sewage to the works.

THE WALLS OF THE EAST BOSTON TUNNEL are kept dry by a false lining, which conducts any seepage down to the invert and prevents it from reaching the exposed face of the tunnel. The following statement concerning it is made in the eleventh annual report of the Boston Transit Commission:

> After that portion of the tunnel which is under the harbor had been completed according to the original plans, it was found that the leakage, while inconsiderable in amount, spread over the interior wall in such a way as to give an impression of dampness, and was not pleasing to the eye. This portion of the tunnel was therefore lined with ribbed tile of fireproof clay covered with cement, so that the face of the walls is now smooth and comparatively dry. The spaces between the ribs form channels which conduct the leakage to the invert, and thus to the pumps. As a matter of fact the total leakage in the tunnel is about seven gallons per minute, which is much less than in any other tunnel yet constructed under similar conditions.

The total amount of tiling used was 6,600 sq. yds., and the prices bid for setting it in the tunnel varied from $2.05 per sq. yd. to $1.12.

therefore no responsibility for this part of the cost.

The record in Fig. 2 gives (for each shop order) a more detailed description of the type of car, with the time occupied in filling the order, and the cost for both labor and material for the entire order and per car. This page is 23 ins. long and 18 ins. deep, and the records are given consecutively by the shop order numbers. Should a comparison of costs in the first classified record (Fig. 1) show an apparent discrepancy in cost of trucks, for instance, the column of "remarks" in the second record (Fig. 2) may show that while arch-bar trucks made at the shops were used in one case, some patented form of steel truck was used in the other case and involved little or no shop cost. Under this system, therefore, very close account can be kept of the details of cost in each department and in total.

Shop order No.	Kind and number of cars.	Inside length and capacity.	Date commenced.	Date finished.	Total labor.*	Total material.	Total labor and material.*	Labor: one car.*	Material: one car.	Labor and material for one car.*	Remarks.
					$	$	$	$	$	$	
215	500 box cars... (Nos. 80768 to 80766 inclusive.)	80,000 lbs. 40 ft.	8-10-'05	10-15-'05	.....	.....	.....	.....	.....	.....	Cars are equipped with steel Major couplers, New York air brake, wooden trussed brakebeams, Hennessey double-spring friction draft gear, metal center sills, Douglas fir side and intermediate sills, etc., etc.

*NOTE.—The figures in these four columns have 5% added for supervision.

FIG. 2. RECORD OF COST OF FREIGHT CAR CONSTRUCTION; CHICAGO, MILWAUKEE & ST. PAUL RY.

PASSENGER CAR REPAIRS.—All passenger car equipment is repaired by the company, including the sleeping, dining, parlor and other special cars, as these are owned and operated directly by the company and not by the Pullman company. Fig. 3 shows the style of record of cost of these repairs. The blanks are loose sheets, 8½ × 7 ins., and are filed in consecutive order of the car numbers in letter-filing cases, each case containing the cards for cars of certain numbers. If it is desired to ascertain what repairs have been done on a certain car (No. 500, for instance), the proper case is located by its label and all the cards for car No. 500 will be found in place and pinned together. One card may be dated May, 1902, and the next August, 1904, showing that the car was not in the shops for two years. They will also show how long the car was in the shop, what work was done, and at what cost. Separate cards of similar form, but marked "Alterations" or "Wreck" show the cost of special work for alterations or wreck repairs (with the time occupied) so that this special work is kept entirely distinct from the regular service repair work. The blanks are filled out from the records of the shop foremen of the several departments, these being checked by the timekeeper and storekeeper's records. The card (Fig. 3) will show that a certain car went into the shop for repairs on a particular date and was sent out on another date. Then follow the details of cost of labor and material for the several classes of work; these added together, and with a suitable percentage of labor cost added for cost of supervision, give the total cost for repairs.

No extra force is required for compiling and filing these records, the work (for both freight and passenger cars) being done by the regular force of the Master Car Builder's office, under the direction of Mr. James Mehan, Chief Clerk.

PASSENGER CAR PAINTING.—Very systematic records are kept of car painting, not only as to the work done and its cost, but also as to the efficiency of various makes of paint and varnish. In the office of the foreman of the paint shop are five large blackboards, 7 × 5 ft., mounted on one frame and sliding in vertical grooves, so that any one can be pulled down for examination. These are divided into vertical columns for years, with a horizontal line for each car; they cover the period 1893 to 1917, the records from 1887 to 1902 having been transferred to books when the boards were full. One board is for sleeping, dining, parlor, café, private and other special cars (about 150 in all); two are for about 500 day cars (one for the period 1893 to 1902, and the other subsequent to 1902); and two for about 400 baggage, mail and express cars. Small tags or slips of card pinned opposite the number or name of the car show its special equipment, as indicated in Fig. 4.

When a new car is received, a white tag is put in the space for the year, and on this are marked the name of the builder and the date on which the car was received. When a car in service goes into the shop for painting, a chalk mark is made in the proper square on the board, and when it is sent out a tag is pinned in this square. The color and shape of the tag indicates the character of the repair work (see Fig. 4), and on it is marked an index number and the date on which the car left the shop. The index number refers to a book in which is given a detailed record of the work done, while another number refers to a second book in which is recorded the cost of the work.

In addition to these records, for every car sent out a large blank is filled up giving the details of every item of paint and varnish work on the body, roof, inside, trucks, etc., with the amount of material used. The painters weigh their pots before going to work, and after finishing work for the day; they record these weights and the character of the work upon slates, and these are then copied onto the blanks for permanent record. To test the values of paints and varnishes, slips of wood and glass are coated and exposed on a frame in the open air. Test panels on car bodies are also coated, and sometimes two kinds of varnish are used for each side of a car, each covering half the side. Records are kept of these tests, and in some cases adjacent portions of the sheathing are removed and filed as records of the comparative values of the two varnishes.

In the event of the work and cost of paint work upon a certain car being subject to investigation, a glance at the board will show in what years it was shopped for painting and what was the character of the work done. Reference to the first book already mentioned will show the details of the work, and the second book will show the details of cost. These are kept separate for the reason that the latter is a somewhat private matter, while the former is open to more general inspection. Should still further details be required, as to the kind and quantity of paint and varnish used in the various parts of the work, these will be shown by the large sheets above mentioned. These several records occupy very little space, and show in detail the work done and cost of work at every shopping of every car since 1887. Their importance is evident when it is remembered that painting represents from 25 to 40% of the repairs. They can be easily extended and are kept up easily by one man, who also keeps the record of paint and varnish tests, etc. Mr. Schlacter is in charge of the work, and has kept the records for a number of years.

It may be of interest to note that as a result of these investigations and records it has been found that two coats of varnish are sufficient, and that the third coat (rubbing coat) formerly used did not give any results to warrant its cost. It has also been found that when a car needs touching up in the paint shop, it is cheaper in the end to go over it entirely than to touch it up simply in places or patches.

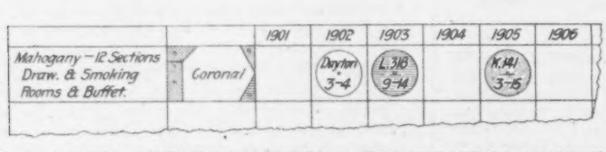


FIG. 4. SAMPLE LINE ON BLACKBOARD FOR RECORDING PASSENGER CAR PAINTING; C., M. & ST. P. RY.

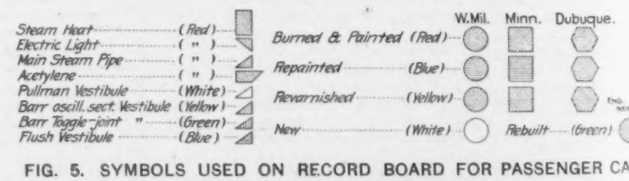


FIG. 5. SYMBOLS USED ON RECORD BOARD FOR PASSENGER CAR PAINTING; C., M. & ST. P. RY.

WHAT METHODS ARE MOST SUITABLE FOR DISPOSAL OF SEWAGE ON THE ATLANTIC COAST?*

By Geo. W. Fuller,† M. Am. Soc. C. E.

During the past two years there have been a number of notable additions to the evidence upon the subject of sewage disposal. It is my purpose to speak briefly of these lines of new evidence, and to say a few words as to practical conclusions which are now available.

SEWAGE, SHELLFISH AND TYPHOID FEVER.

The first feature I will mention is in reference to shellfish pollution and the reports of the Royal Commission on Sewage Disposal for Great Britain. That commission has been at work since the spring of 1898, and it has conducted experiments and has issued reports at intervals for about five years. The report which was issued some 18 or 20 months ago was devoted to the infection of shellfish, to the pollution of seacoast water and to the life of disease germs, such as typhoid fever, in shellfish and in coast waters. Some of the British shellfish are taken from waters which are not above suspicion as to sewage pollution. In London and Manchester it has been concluded after careful investigations that about 8% to 10% of all typhoid fever in those cities has for some years been caused by infected shellfish. In several seaport towns the proportion has reached over 50%. Although a commission has been working on this subject for several years, many practical features are still unsolved. These unsolved problems relate especially to those cases where the pollution is slight or occurring only at intervals. Where the pollution is excessive or absent the treatment is obviously simple.

I also wish to call your attention to the work which has been conducted by the Massachusetts State Board of Health during the past two or three years with reference to shellfish and sewage disposal, especially on the seacoast. This board has, since 1886, devoted sums ranging from $20,000 to $35,000 each year for work in matters of water supply and sewage disposal within the limits of that State. You are all familiar, of course, with the investigations made at Lawrence, where an experiment station has been maintained for nearly 20 years. You are also aware of the fact that all improvements in the cities and towns of Massachusetts with reference to water supply and sewage disposal have first to be passed upon favorably by the State Board of Health before the Legislature gives permission to issue the necessary bonds. After progressing some 15 to 18 years along this general line the Massachusetts Legislature directed the State Board of Health to make special inquiry as to shellfish, and also as to the manner in which sewage was disposed of by all leading cities and towns of the State. On this subject the recent Massachusetts reports contain most valuable evidence.

SEWAGE DISPOSAL BY DILUTION.

In regard to disposal along seaport towns there is necessity of improvement in the majority of instances. With few exceptions, the sewage is disposed of by dilu-

*Address at a meeting of the New Jersey Sanitary Association, Lakewood, N. J., Dec. 9, 1905.

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lower figure is still above 3,000 lbs. per sq. in. the loss in strength may be neglected.

The Philadelphia Building Bureau adopted these regulations in toto at the time, but has recently modified them so far as they relate to concrete building blocks. Their requirements are as follows:

14. The following requirements must be met to secure an acceptance of the materials: The modulus of rupture for concrete blocks at 28 days old must average 150 and must not fall below 100 in any case. The ultimate compressive strength at 28 days must average 1,000 lbs. per sq. in. and must not fall below 700 lbs. in any case. The percentage of absorption (being the weight of water absorbed divided by the weight of the dry sample) must not average higher than 15% and must not exceed 20% in any case. The reduction of compressive strength must not be more than 33⅓%, except that when the lower figure is still above 1,000 lbs. per sq. in. the loss in strength may be neglected.

We are not prepared to defend these requirements against all criticism; in fact, any information of tests that would establish the correctness or the unfairness of these requirements would be most welcome. This much, however, must be said, that thus far several new materials have met the New York requirements, and among them cement brick. No concrete building blocks have yet been tested in accordance with these requirements. While it would seem that some change is desirable for the benefit of the building block, it is believed that the Philadelphia requirements are too low. It may be true that by virture of the larger size of the units a wall built of building blocks has some advantages of strength over one built of smaller units, such as common brick; still, so great a drop in ultimate compressive strength below that required for brick or stone concrete as is permitted by the Philadelphia regulations seems unreasonable. No one contends that an ultimate compressive strength of 2,000 lbs. at 28 days for concrete, or of 2,500 lbs. for brick, is too high; yet it is proposed to accept building blocks with an ultimate compressive strength of 1,000 lbs. at 28 days, and even then make no provision for extra thickness in a wall built of building blocks above that required for brick or Portland cement concrete.

B. For Reinforced Concrete.—In the case of reinforced concrete, however, the question of the mixture must be disposed of in a different manner. Reinforced concrete construction is put up in place. The component parts (concrete and steel) are differently disposed for varying conditions of shape, span and loading. The entire construction must be carefully planned beforehand, every part must be definitely fixed, and the size and position of each element must be determined by calculation. In order, therefore, that any governmental control in such a case may be had, a definite mixture must be used, the physical characteristics of which (crushing strength, modulus of elasticity, adhesive power, resistance to shear) are well known; and the law-making power is fully justified in prescribing such mixture for all work of that kind under its jurisdiction. What that mixture should be will again depend somewhat on local conditions, for it would certainly be out of all reason to prescribe a trap rock mixture in a locality where trap rock is commercially unobtainable.

The New York regulations permit a variation in the mixture from the prescribed proportions of 1 : 2 : 4 so long as it can be demonstrated by tests (under the supervision of the bureau) that the compressive strength at 28 days does not fall below 2,000 lbs. per sq. in. Experience has shown that very little latitude should be allowed in this matter of variation of mixture, as it is practically impossible to properly control the construction where more than one mixture is used. If the designers could be held criminally responsible for their results, no limitation of this kind would be needed; but so long as the building authorities are held to a partial accountability they are fully justified in insisting on a single well-known mixture for reinforced concrete construction.

Before dismissing this question of materials and mixtures one other commonly used mixture should be considered, namely, cinder concrete. The excellent fire-resisting quality of this concrete makes it a most useful building material. Its great lack of uniformity and its consequent unreliability in strength make it necessary to exclude it from consideration as a construction whose strength is calculable. The practice in New York is to insist on load tests on full-sized constructions for every variation in span and detail of construction, in order to determine allowable working loads. Floor constructions are here alluded to, as that is practically the only form requiring strength in which it is used. The factor of safety demanded is ten—that is, the section of floor to be tested is loaded till it breaks—and one-tenth of the uniformly distributed breaking load is taken as the working load.

LEGAL REQUIREMENTS FOR WORKMANSHIP.—Good workmanship is important in all construction, but in no form of construction is it so important as in reinforced concrete; and in that form of construction it is no more and no less important than good materials or good design. So far as law is concerned, however, workmanship may be dismissed in a few words. The law can simply demand that all possible care be exercised in securing it. It will always be secured if there is competent supervision. Competency is secured by study and experience. It is not necessary to go into such details as cautioning against freezing mortar, using cements that have begun to set, where there is competent supervision. There would be no end to these detailed requirements if once begun. How to secure competent supervision in all cases, especially where builders and owners are unwilling to pay for it (though it is an excellent investment), is a difficult problem. The following suggestions may, however, be a step toward the solution. Let it be made compulsory that every building operation shall be in charge of a licensed inspector or superintendent, who shall have received his license from a competent examining board, and who shall be criminally responsible for the work and infraction of the law. The details of this plan have no proper place in this paper, for they are of general application and not peculiar to this form of construction.

CONTROL OF DESIGN.—For the design of a structure the designer must always be responsible. The supervision of the design by the building authorities should only be to assure that the allowable working stresses have not been exceeded, that the prescribed floor capacities are provided, that proper light and ventilation are secured, etc.; in fact, that the general provisions of the law are complied with. To go beyond this is to relieve the designer of that much responsibility and to place it where it does not belong.

PUBLIC RECORD.—Building departments or bureaus should be bureaus of record, and the records should be complete. The Prussian regulations on reinforced concrete go so far as to even demand that a copy of all calculations as to strength be filed, although they may not be checked over.

There is a great tendency to particularize in our laws and to add provision upon provision, to make more and more a complete specification of the law. Instead of this, as has already been stated, only fundamental principles should be included in the law. The designer should be allowed all possible freedom, but at the same time he must be made absolutely responsible for his work. So long as these conditions do not obtain it is perhaps better that the law should go farther than necessary in prescribing limitations. Under such circumstances it is to the interest of the good and honest designer and builder and user of cement that the law should err on the safe side and take a conservative position.

EXISTING LAWS.—New York city was the first municipality in this country to prescribe regulations on the use of reinforced concrete. They were drawn after much study and considerable discussion among experts at a time when the construction was not widely known. That they have been fair and good is attested by the fact that with not many changes the requirements on that form of construction, laid down in the model building code recently proposed by the National Board of Fire Underwriters, are those of New York city. And these latter requirements were, as stated by one closely connected with their promulgation, the result of study, of suggestions and criticisms of many engineers and experts. Besides these two codes, there are ordinances in Chicago, Cleveland and Denver.

Taking up in more detail the fundamental principles to be laid down for the guidance of the designers, these should include: (1) The allowable stresses in the materials; (2) the methods used in calculating the stresses produced; (3) the guiding principles in determining the resistance to these stresses. It is generally conceded that the tensile strength of concrete should not be considered. The New York, Chicago and Cleveland laws prescribe working stresses, but the proposed code of the National Board of Fire Underwriters prescribes a factor of safety applied to working loads and the use of ultimate stresses. It is not proposed to discuss here the superiority of either method over the other, as both will give safe results if intelligently used.

The following stresses should be used, and are those prescribed by the laws cited, the ultimate stresses being those used by the National Board of Fire Underwriters:

	Stress, lbs. per sq. in. Working.	Ultimate.
For extreme fibre stress of concrete in compression	500	2,000
For shearing stress in concrete	50	200
For concrete in direct compression	350	
For tensile stress in steel	16,000	
For shearing stress in steel	10,000	
For adhesion of concrete to steel	50	200

The Denver ordinance gives no stress values, but refers to a handbook—a practice that is not to be commended. The Chicago ordinance permits a shearing stress in concrete and adhesive value of 75 lbs. per sq. in., which is too high. On the tensile value of steel there is also a difference, only New York and Cleveland fixing a definite figure—16,000 lbs.—and Chicago permitting one-third of elastic limit. On this point there is much opportunity for discussion. The writer believes a definite value should be adhered to, and that should be 16,000 lbs. working stress. It is generally believed that the adhesion of concrete to steel may be taken the same as the shear of concrete. The Denver law, however, prohibits the use of plain bars. This is an unjust limitation on the designer, so long as the safe limit of adhesion is not exceeded. When this occurs all the laws are agreed that other provisions should be made. So, too, would it be an unfair requirement to prescribe the use of stirrups unless the safe resistance to shear is exceeded, or to insist on the use of certain bars to secure rigid attachment of stirrups. This is no more important than the placing of the tension bars in their exact position, which must be taken care of in the supervision of the construction.

The Cleveland law makes provision for compression in steel. This is unnecessary, as the allowable compression in the steel must depend on the assumption of the ratio of moduli of elasticity of the two materials, unless the steel is designed to take all the load, in which case we are no longer dealing with reinforced concrete. The maximum ratio of length to diameter of columns is fixed at 12 in all but the Denver law, where hooping is required when the ratio exceeds 4.

In the calculation of bending moments and the determination of moments of resistance the practice is quite uniform, and the New York provisions are suggested as sufficiently full:

13. The following assumption shall guide in the determination of the bending moments due to the external forces: Beams and girders shall be considered as simply supported at the ends, no allowance being made for continuous construction over supports. Floor plates, when constructed continuous and when provided with reinforcement at top of plate over the supports, may be treated as continuous beams, the bending moment for uniformly distributed loads being taken at not less than $\frac{WL}{10}$. The bending moment may be taken at $\frac{WL}{20}$ in the case of square floor plates which are reinforced in both directions and supported on all sides. The floor plate to the extent of not more than ten times the width of any beam or girder may be taken as part of that beam or girder in computing its moment of resistance.

14. The moment of resistance of any concrete-steel construction under transverse loads shall be determined by formulae based on the following assumptions:

(a). The bond between the concrete and steel is sufficient to make the two materials act together as a homogeneous solid.

(b). The strain in any fibre is directly proportionate to the distance of that fibre from the neutral axis.

(c). The modulus of elasticity of the concrete remains constant within the limits of the working stresses fixed in these regulations.

From these assumptions it follows that the stress in any fibre is directly proportionate to the distance of that fibre from the neutral axis.

The tensile strength of the concrete shall not be considered.

It is believed that these provisions go as far as necessary (they are somewhat more elaborate in the National Board of Fire Underwriters' code) and do not hamper the designer unnecessarily. For a comparatively new form of construction, in which uniform practice is not yet thoroughly established, it cannot be said that they go too far.

Regarding the use of concrete building blocks in the design of new buildings, an important question arises as to the height to which they shall be allowed in walls. Chicago restricts their use to dwellings and stables not more than two stories in height. Cleveland allows them for buildings of ordinary (non-fireproof) construction four stories in height. Philadelphia permits them for six-story buildings. Their use is not yet allowed in New York (Manhattan).

Concrete is generally assumed and frequently accepted as fireproof. The later laws on concrete recognize it as fireproof and prescribe minimum thicknesses to be used for covering the embedded metal. That concrete is incombustible cannot be denied; that it will not disintegrate under fire cannot be maintained (stone and gravel concrete only being considered now). The New York building authorities have made 14 fire tests on concrete constructions, of which seven proved successful. It would seem that in the cases of failure the concrete when tested was too green; that is to say, it contained too large a percentage of uncombined water, which was converted into steam and caused the disruption of the concrete. This makes it necessary to guard against the occupancy of concrete structures within the time required for the concrete to appropriate all its water. That a reinforced concrete building is far superior as a fire-resisting structure to a mill constructed building must be conceded; that it is equal to the best type of fireproof construction cannot justly be claimed.

The best practice in this particular is that given in the code of the National Board of Fire Underwriters, as follows:

Reinforced concrete construction may be accepted for fireproof buildings if designed as hereinafter prescribed; provided that the aggregate for such concrete shall be hard-burned broken bricks or terra cotta, clean furnace clinkers, entirely free of combustible matter, clean broken stone or furnace slag, or clean gravel, together with clean siliceous sand, if sand is required to produce a close and dense mixture; and, provided further, that the minimum thickness of concrete surrounding and reinforcing members ¼-in. or less in diameter shall be 1 in.; and for members heavier than ¼-in. the minimum thickness of protecting concrete shall be four diameters, taking that diameter, in the event of bars of other than circular cross-section, which lies in the direction in which the thickness of the concrete is measured; but no protecting concrete need be more than 4 ins. thick for bars of any size; and, provided further, that all columns and girders of reinforced concrete shall have at least 1 in. of material on all exposed surfaces over and above that required for structural purposes; and all beams and floor slabs shall have at least ¾-in. of such surplus material for fire-resisting purposes; but this shall not be construed as

AN ENGLISH DOUBLE DECK STREET RAILWAY CAR.

As most of our readers are aware, the street railway lines in European cities are generally equipped with cars having seats on the roof. Frequently these seats have no roof over them, or sometimes a light canopy or awning cover is used; but in the car herewith illustrated the upper deck is entirely enclosed with glass windows so that it may be used with comfort in all weathers.

The car shown has a further interest to American readers in that it is part of a municipally-owned and operated electric railway. It is coming to be nearly as common for an English city to own and operate its street railway lines as it is for an American city to own and operate its water-works.

DOUBLE-DECK ELECTRIC CAR ON THE MUNICIPALLY-OWNED STREET RAILWAY LINES OF BIRKENHEAD, ENGLAND.

The city of Birkenhead, which is located on the opposite side of the Mersey estuary from Liverpool, has hitherto operated its street railway lines with open upper deck cars, and in inclement weather extra cars have had to be run to carry the passengers. Four covered deck cars of the type illustrated have therefore been tried and have shown such good results that twelve more cars are to be built in the corporation shops, or rather covers are to be placed on twelve of the present double-deck cars.

The car is 33 ft. 6 ins. long over all, and has a width of 7 ft. 3 ins. The height over the trolley base is 17 ft. 1½ ins. The seats on the top deck run transversely with a central aisle, and the total seating capacity of the car is 76 passengers, which is, we believe, considerable in excess of the seating capacity of even the longest and heaviest of American street railway cars.

One reason, doubtless, why American street railway companies have never favored double-deck cars is that they have found it more profitable to carry passengers standing than seated. Leather straps from which passengers can hang themselves are far cheaper than are upper decks. They do these things differently on the other side of the water, and while it is undeniably annoying to stand on a street corner while car after car passes in which all seats are taken, the net effect of the stringent requirement of a seat for every passenger is to compel the street railway company to keep in service cars enough and with seating capacity enough to reasonably accommodate the public.

An objection frequently brought against double-deck cars is the length of time taken for a passenger to get on or off; but with cars of this type run without permitting standing passengers, it is quite possible that the average length of stop would be less than with a long American car when the aisle is jammed with standing passengers.

LEGAL REQUIREMENTS IN REGARD TO CONCRETE BUILDING CONSTRUCTION.*

By Rudolph P. Miller, M. Am. Soc. C. E.†

QUALITY OF CEMENT.—Cement is used in different ways in building construction; most extensively in mortar, very largely in concrete, both plain and reinforced; in increasing quantities in building blocks; also for cement bricks, artificial stone, stucco, and in perhaps other less important ways.

In whatever way cement may be used in construction, its quality should be up to a certain standard, and it is properly within the province of the law-making power to fix that standard, or at least to recognize some standard otherwise established and recognized. This may be done either by giving a complete specification in the law, or by authorizing the executive officer of the building bureau or department to prescribe, within proper restrictions, the requirements which all cements must meet. The former way is the less desirable, not only in the particular matter under discussion, but in all building law, as it retards progress and makes no provision for new materials and processes or improvements. Building laws should be sufficiently flexible to be capable of meeting new conditions. This can be best accomplished by laying down in the law only fundamental principles and investing the executive officer with power to fix the more definite requirements. That this power may not be abused, it should be restricted to such an extent as to require the publishing of all proposed requirements, and the holding of public hearings, if demanded, before the same become effective.

In the case of cement, the fundamental principles should be such as to secure strength and soundness. As to the more specific requirements, nothing better could be done than to adopt a standard specification promulgated by some organization of recognized national reputation, such, for instance, as that of the American Society for Testing Materials. No specification ever drawn satisfied everybody, but one presented by such an organization might well receive legal sanction, even though it may not in some particulars meet the views and criticisms of the building official immediately concerned.

As to strength of cements, the present New York Building Code requires the tensile strength of neat briquettes to be:

	Lbs. per sq. in. Nat. cement.	Port. cement.
After 24 hours set in air....	60	120
" 1 day in air and 6 days in water	120	500

In the case of natural cements the requirements of the building code are still considered satisfactory in general practice, but for Portland cements the accepted present standard of general practice is higher; it is 200 lbs. after 24 hours in air and 500 lbs. after one day in air and six days in water, which is fully 66.6% higher than the old building code standard. This illustrates in a measure what has been said about the flexibility of law. As conditions improve it should be possible for the building official to demand the use of the up-to-date material.

Neither the New York Building Code nor any other building law that has come to our attention makes any provision for soundness, and yet this would seem to be the more important property of a cement. A contractor or speculative builder would possibly not care whether his structure lasted beyond the final payment or the transfer of the property, but the interests of the public demand that it shall. In some cases self-interest would also require lasting qualities. The manufacturer of concrete building blocks or cement brick could not afford to have his product disintegrate in six months or a year after it had been put into a building; and yet this would happen if his cement should be unsound. So long as cements were used in constructions where the individual masses were large and unbroken the importance of soundness in cement was not so apparent. But since the introduction of building blocks, and especially of reinforced concrete construction, this matter becomes of first importance. Imagine the consequences of the disintegration (due to unsound cement) of a concrete column in the basement of a heavily loaded five-story warehouse.

Municipal inspection bureaus could not, of course, inspect all cements used in building operations, nor is it the function of the government to do so. The law should require, however, as it does in New York, that all brands of cements be tested under the supervision of the proper official at such times and as often as may be deemed necessary; that a record of all cements answering the lawful requirements be kept for public information, and that no other cements be used. The law should further prescribe that all cements used in important work, especially in work where the masses in the individual members composing the structure are comparatively small (compared to the entire mass), such as reinforced column and floor work or building block manufacture, should be tested for strength and soundness by the contractor or manufacturer at some reputable laboratory, and a certified copy of such tests filed with the proper building official.

PROPORTIONS AND QUALITY OF ASSOCIATED MATERIAL.—Mortar and concrete, it may be said, are the forms in which cement for building purposes is always used. It is therefore quite within the province of the law to prescribe the characteristics of the other component materials other than cement. These may be one or several of a number of materials—sand, gravel, broken stone of many varieties, slag, cinders, broken brick, etc. The extent to which any of these materials is used will depend largely on local conditions. The proper proportions in which they are used vary with the material and the sizes used. To get the best results the mixture must be well balanced, the smaller particles filling the voids of the larger, and the cement completing the mass by binding all together. In consequence it becomes difficult to prescribe by law mixtures and proportions that will secure the best results, as any one of the several materials specified may not always run uniform in size, and the proportions would very properly be changed continually to meet the new conditions. How, then, shall the law control mixtures to secure safe and just results?

A. For Manufactured Units.—In the case of a material or mixture that is made up into shapes and units and sent to the structures to be used, a certain standard of strength should be fixed by law, and the maker should be required to test his product under the direction of the building official. If necessary or desirable, certain limiting proportions might also be prescribed, but so long as the product of any plant meets the prescribed standard of strength the particular proportions or materials used are of small moment. This requirement would apply to such materials as building blocks, cement bricks, artificial stone, etc., or such as can be easily bought in the open market.

About nine months ago the New York Bureau of Buildings promulgated certain requirements as to strength and other characteristics for materials of this nature and the conditions under which tests shall be made and approvals issued. The requirements conditioning the acceptance of the materials were based on the results of an elaborate series of tests on common brick as delivered in the New York market, and on the theory that any new material should be at least as good as that most commonly used. These regulations containing the requirements were published in the technical journals, and it was hoped at that time that they would bring forth such discussion and criticism as would be useful in determining whether the requirements were fair, or perhaps too severe. Thus far no objections based on reliable data have been made, and this is probably due to the total lack of definite information.

Section 14 of the New York regulations is as follows:

14. The following requirements must be met to secure an acceptance of the materials: The modulus of rupture must average 450 and must not fall below 350 in any case. The ultimate compressive strength must average 3,000 lbs. per sq. in. and must not fall below 2,500 in any case. The percentage of absorption (being the weight of water absorbed divided by the weight of the dry sample) must not average higher than 15% and must not exceed 20% in any case. The reduction of compressive strength must not be more than 33⅓%, except that when the

*Abstract of a paper read at the annual meeting of the National Association of Cement Users, Milwaukee, Wis., Jan. 12.

†Chief Engineer, Bureau of Buildings, Borough of Manhattan, City of New York.

increasing the total thickness of protecting concrete as herein specified.

Of the fireproof quality of cinder concrete there can be no question, as already intimated. The 36 tests made under the supervision of the New York Building Bureau would remove any doubt in the matter. On the fireproof character of walls of concrete building blocks very little is known, and information is much desired.

The weathering qualities of concrete, more especially in the shape of building blocks, should be fully and carefully investigated. Some freezing tests made for the New York Building Bureau on cement blocks indicated a tendency of the material to distend, and a loss in compressive strength of about 40% resulted. On concrete building blocks the absorption is probably high (this is not based on actual observation), and a deterioration of the material in freezing seems likely. To guard against danger in this respect the following New York provision is desirable:

That the freezing and thawing process must not cause a loss in weight greater than 10%, nor a loss in strength of more than 33⅓%, except that when the lower figure is still above 3,000 lbs. per sq. in. the loss in strength may be neglected.

To this may be added that if the lower figure is still above 2,000 lbs. per sq. in. the loss may be as much as 50%, but no more.

In conclusion, it may be said that of all the suggestions made in this paper the most important is the one fixing the responsibility for bad design and bad workmanship. It is decidedly in the interest of every cement user that so valuable a structural material as cement should be applied honestly and intelligently, leaving no chance for its condemnation because of improper or irresponsible work.

THE ILLINOIS STATE WATER SURVEY.*

By Edward Bartow.†

The State Water Survey of Illinois was instituted in September, 1895, by the late Prof. A. W. Palmer, of the University of Illinois, and on July 1, 1897, a law establishing a chemical survey of the waters of Illinois was in force. This law authorized the university to collect information concerning the water supplies of the state; to collect samples of water from wells, streams, and other sources of supply; to subject these samples to such chemical and biological examinations and analyses as shall serve to demonstrate their sanitary condition; to determine standards of purity of drinking waters for the various sections of the state, and to publish the results of these investigations.

In the ten years during which this work has been carried on, 13,873 samples of water have been received at the laboratory. The work has been mainly of a sanitary-chemical nature, though some bacterial examinations have been completed. Of the samples analyzed, 5,376 have been sent to the laboratory by private parties. About 2,800 were made in connection with the investigation of the Illinois River for the Sanitary District of Chicago. The remainder of the work has been in connection with special problems, such as an investigation of the effect of sewage on small streams, and the examination of test wells. Two reports have been published by the survey and some of the work has been published in the Report of Streams Examination, Sanitary District of Chicago. In addition to the published reports, the results of analyses, with opinions as to the potability of the water examined, have been mailed to the private parties sending samples. The next bulletin will contain a report on the mineral analyses of about 620 waters.

The work of the survey was carried on under the direction of Professor Palmer until the time of his death. Since his death in February, 1904, the work has been under the general direction of Prof. S. W. Parr, until the present director took charge in September, 1905. The laboratories of the Survey are located in the north wing of the Chemistry Building of the University of Illinois, thus having the benefit of the equipment of the chemical laboratory.

The problems of a water survey are of vital interest to other surveys or boards concerned with the public welfare, and on this account plans have recently been consummated for cooperation between the State Water Survey and the State Board of Health. In this cooperative work, the State Board of Health will take as its specialty the investigation of epidemics of water-borne diseases and the examination of sewage treatment plants. The survey will assist in these problems by analyzing the samples delivered to it by the State Board of Health. It will also continue the examination of municipal and other water supplies of the state, having the assistance of the State Board of Health in the investigation of water plants.

In cooperation with the State Geological Survey a systematic study of the quantity and quality of the water from deep wells of the state will be made. The State Geological Survey will collect data regarding the wells, including the depth, rate of flow and the strata through which they pass, collecting and shipping samples to the State Water Survey laboratory for analyses and reports. By this investigation we in time hope to be able to have data which will enable cities or manufacturers to learn the approximate depth at which a suitable water may be obtained, and also to learn the probable flow and the quality of the water from such wells.

In cooperation with the Division of Hydro-Economics of the United States Geological Survey, examinations will be carried on to determine turbidity and average mineral content of the streams. Since it has been proved possible by sedimentation, precipitation, or filtration to purify practically any water, the data thus obtained will be valuable in showing the average amount of sediment to be removed. This will enable engineers to calculate the size of filter plants to be installed, the probable amount of the coagulant to be used and also to determine the style of plant best fitted for varying conditions.

*Abstract of a paper read at the annual meeting of the Illinois Society of Engineers and Surveyors, at Rockford, Ill., Jan. 17 to 19, 1906.

†Director of the State Water Survey, Urbana, Ill.

ELECTRIC MOTOR CENTRIFUGAL PUMPING PLANT FOR DRAINING THE TORRESDALE TUNNEL, PHILADELPHIA.

A simple and efficient pumping plant, which promises to have a field of wide usefulness in shaft sinking operations, has been recently devised and successfully operated in draining the Torresdale conduit of the new filtered water supply of Philadelphia, Pa. The plant comprises as its distinctive elements two high speed De Laval electric motor centrifugal pumps. These pumping units were suspended by slings operating from the top of the shaft, and received their power from a temporary installation of generators and engines near the mouth of the shaft. The general arrangement of the pumps in the shaft and of the shaft head structures is shown by the drawings of Fig. 1 and by the views Figs. 2, 3 and 4.

A full description of the Torresdale conduit was published in Engineering News of Dec. 1, 1904. Briefly described, it consists at the Torresdale end of a vertical shaft, 10½ ft. in diameter, which connects by a vertical curve with a circular tunnel, also 10½ ft. in diameter, which extends to Lardner's Point, where another vertical curve connects it with a second vertical shaft rising to the surface. The length of the tunnel between centers of shafts is 13,809.18 ft., and it has an up-grade from Torresdale to Lardner's Point of 9 ins. in 1,000 ft. The conduit is at a depth of some 120 ft. below the surface, and penetrates rock for its entire length. After completion the tunnel developed considerable leaks, and it is for the purpose of laying the tunnel dry for the examination and repair of these leaks that the pumping plant illustrated has been installed by the D'Olier Engineering Co., of Philadelphia, Pa., which has the contract for pumping out the tunnel and keeping it dry. The pumping plant was installed in the Torresdale shaft, the drainage grade being toward this shaft.

The pumping operation would have been a comparatively simple one if it had not been for the fact that there is a considerable amount of leakage into the conduit, and consequently it was necessary to overcome this in addition to pumping out the actual capacity of the conduit. The contractors selected as the pumps for this work De Laval electric motor centrifugal pumps, running at a speed of 1,500 r. p. m., and used two of them, each capable of delivering 1,200 gals. of water per min. against a head of 130 ft. The pumps are single stage double suction type, and are made with the pump cases divided horizontally, the arrangement being such as to allow easy access to all working parts of the pump. Each pump, with its motor, to which it is connected by a flexible coupling, is mounted on a single sub-base, which in turn is supported on a heavy timber platform swung from steel cables passing over iron sheave blocks on the head frame of the shaft. The arrangement is clearly shown by the illustrations.

On account of the restricted space in which the pumps had to be operated, it was necessary to place one pump vertically over the other, and the handling apparatus was so arranged as to

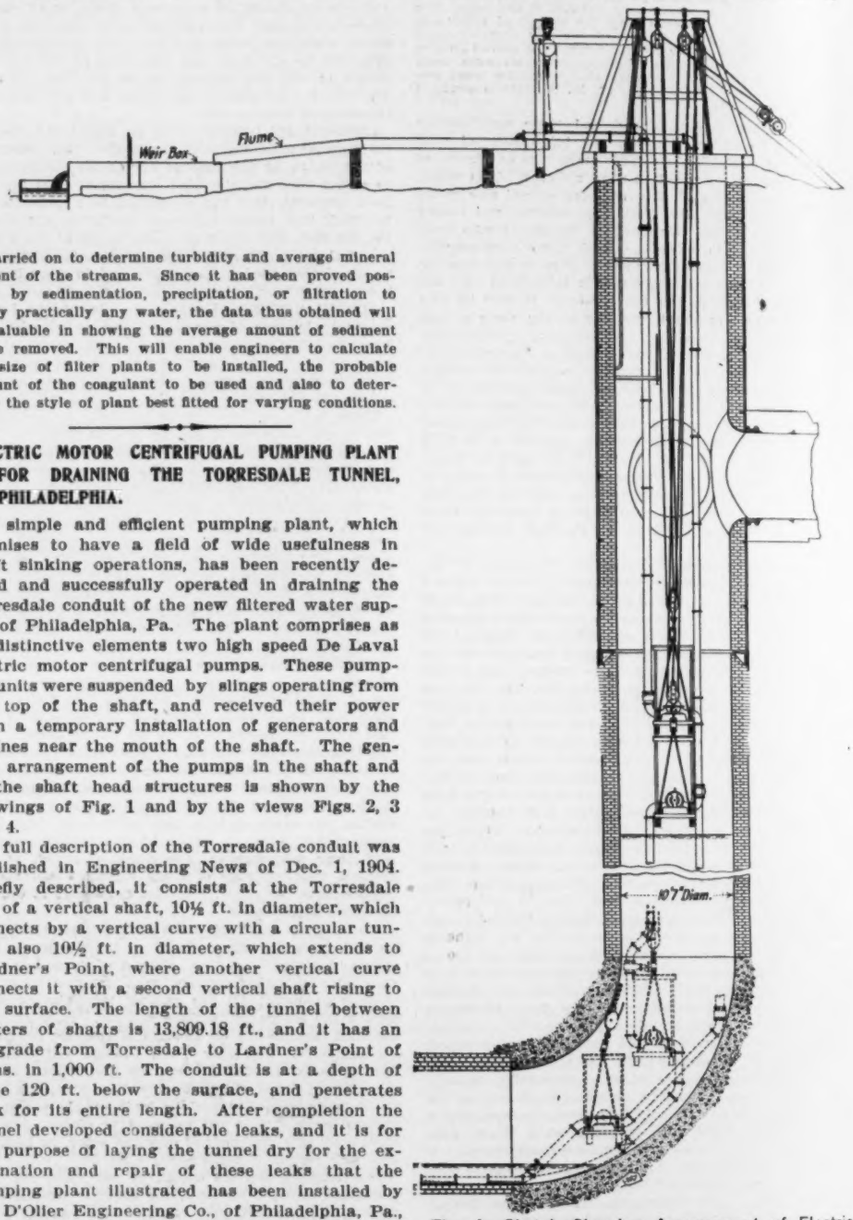

Fig. 1. Sketch Showing Arrangement of Electric Motor Centrifugal Pumping Plant in Shaft of Torresdale Conduit.

allow the pumps to be lowered independently, it being necessary, of course, to lower them as the water level receded. At the beginning of the work the water level stood about 30 ft. from the top of the shaft. Before work was commenced the water in the conduit and the external pressure were in equilibrium, and on beginning pumping the leakage was comparatively small. This, however, increased very rapidly as the water level was reduced, and finally was such that not only was it more than one pump could handle, but progress even with two pumps in operation was extremely slow.

When necessary to lower the pumps one of them was kept in sevice while the other was being lowered and the discharge pipe lengthened by addition of flanged sections. In order to avoid strains on the pump flanges, the weight of each

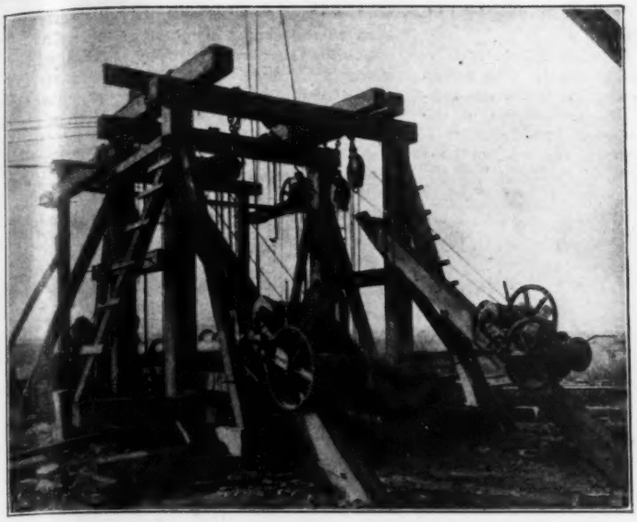

FIG. 2. REAR VIEW SHOWING HOISTING WINCHES AND TACKLE.

FIG. 3. FRONT VIEW SHOWING DISCHARGE PIPES.

discharge pipe was carried separately by chain hoists.

After the contractors had been pumping some days they encountered some difficulty due to the formation of a hard lime deposit or scale in the pump case and on the pump impeller. The deposit in the case did not interfere with the operation, but the scale on the impeller had the effect of cutting down the quantity of water delivered. This scale was found to be practically pure carbonate of lime, and was consequently soluble in dilute hydrochloric acid. On account of the leakage of the conduit, however, being more than one pump could handle, it was necessary to avoid shutting down either pump for any period more than a few minutes, and consequently a spare impeller shaft and all running parts of the pump were kept on hand. When a coated impeller was removed a clean impeller was immediately substituted, very little time being lost in making the change, and the coated impeller was cleaned at leisure in the acid bath.

It will be readily appreciated that the formation of such a scale would have seriously hampered the operation of reciprocating pumps or that it would have rendered useless centrifugal pumps not arranged for ready access to the interior by means of the horizontally split case.

The pumps were primed by the use of check valves kept below the surface of the water. In addition, the pumps were provided with steam exhausters to which connection was made from the steam supply at the surface by means of steam hose.

The contractors installed a very complete plant for supplying electric power to the motors driving the pumps. The plant consists of two 80-HP. Ball engines, two Crocker-Wheeler belted dynamos and two tubular boilers, together with complete equipment of pumps, feed-water heater, switchboard and all the usual accessories of a power plant. In fact, although installed for only temporary service, the plant is such as would be a very efficient and reliable one for permanent use.

Since the conduit has been pumped out the contractors are obliged to keep their pumps running day and night in order to prevent it from filling up again. On a previous occasion, when the pumps were withdrawn, the conduit filled in about one week. We are indebted to the contractors for the information from which this description has been prepared.

A NEW PROCESS OF ZINC PLATING.

In a paper, by Mr. Sherard Cowper-Coles*, on "The Metallic Preservation and Ornamentation of Iron and Steel Surfaces," recently read before the Society of Engineers, London, the author described a new process of zinc plating, which is carried out as follows:

The article, plate or tube to be coated is freed from scale and oxide, and is then placed in a closed iron receptacle or drum charged with zinc dust, and it is then heated to a temperature of from 500° to 600° F. for a few hours and allowed to cool. The whole of the zinc is deposited on the surface of the articles in the drum.

The process has also been successfully applied to coating iron with aluminum, copper and antimony; also to coating various other metals, such as aluminum and copper, with zinc. Copper and its alloys become case-hardened by the process. Articles coated with grease are claimed to receive a coating as good as, if not better than, those free from grease.

The dry galvanizing process is similar to the hot process in that the zinc alloys with the iron and forms a protective zinc-iron alloy between the pure zinc coating and the iron.

The dry galvanizing process is applicable to the decorative inlaying of metallic surfaces, similar to damascening. The metals can be blended together to form alloys of many colors and tints. The process is effected by first coating the article with the metal covering the bulk of the article, then after laying a stopping-off composition on the surfaces which it is desired to leave uncovered, and baking the article in the dust of the metal overlaid on the remaining surfaces. The intermediate colorings and alloys are obtained by manipulation of the stopping-off composition. For instance, a copper tray can be inlaid with zinc, the materials being arranged so that a great part of the copper is changed into gold-colored brass. The whole range from the zinc through yellow brasses and bronzes to red copper can be effected in the same article.

FIG. 4. VIEW SHOWING LOWER PUMP IN ITS FINAL POSITION IN SHAFT.

TRACK CONSTRUCTION IN MINES.*

By Leo Gluck.†

The limitation of space for mine tracks and the car clearance necessitates the use of curves of small radii, large frog angles, cars with small wheels and short wheel base, all differing from the usual surface railway practice. Where double tracks are used, the track centers are such that the distance between the two inner rails is usually less than the gage, so that when double crossings or turnouts are necesary, the layout becomes special and complicated.

In mines operated by double-compartment hoisting shafts, where there are parallel tracks on each side of the shaft landing, one of them (usually the right-hand track) is for storage of loaded cars, the other for the empty cars. From each right-hand track, on its corresponding side of the shaft, loaded cars are run on the

*Artillery Mansions, Victoria, So. London, S. W.

*Abstract of a paper read at the annual meeting of the Illinois Society of Engineers and Surveyors, Rockford, Ill., Jan. 17, 19, 1906.

†Chief Engineer, Spring Valley Coal Co., Spring Valley, Ill.

cage which push the empties from the cage to the opposite side of the shaft to the storage track for empty cars. If, for any cause, one of the loaded car-tracks is blocked, so that the cars from that side cannot be loaded on the cage, the empty car, of course, can be taken from the cage to the track for empties; but in order to place a loaded car on the cage opposite the empty track a double, or diamond, crossover switch is used on both sides of the shaft landing. Cars can then be crossed from either one of the tracks to the other.

The main advantage of the crossover switches is that the supply of empties on each side of the shaft can then be regulated without crossing from one of the landings to the other, or "cross-caging," in case one or the other of the tracks become blocked. In modern tipples the diamond switches are used to advantage, being placed between the shaft and the weighing and also the dumping apparatus. In case of a disarrangement of the weighing or dumping appliances, the cars can be crossed from one track to the other and all without delaying the hoisting in the shaft.

The double crossover or diamond switch, in general, for mine work, consists of two parallel tracks connected by circular curves. It differs from the double crossing of railway practice for the reason that the distance between the two inner rails is usually less than the gage of the tracks, so that the diamond part of the crossing is included, in part, inside of the gage of the parallel tracks. In railway practice the diamond is always completely included between the two inner rails, and, therefore, is a true diamond and very simple and always the same for the same frog angle and independent of the gage of the tracks and the distance between parallel track centers.

The gage of tracks is determined by the size of the roadways, and this, in part, fixes the size of the hoisting shaft. The distance between track centers is fixed by the size of the hoisting compartments in the shaft. But the radius of the turnout curve is dependent on the distance between track centers as well as the gage of the track; so that the turnout radius, other conditions being fixed, determines the distance between track centers.

The frog angle has certain limitations. As the frog angle increases, the radius of the turnout curve decreases, the limitation being the ease with which cars of a certain wheelbase can go around the curve. As the frog angle decreases, the radius of the turnout increases, the limitation being that the turnout becomes too long, thereby requiring too long a time in making the crossing; also, increasing that part of the crossing at a corresponding loss of car storage on each side of the shaft landing.

In the design of a double-diamond crossover the aim is, after having the gage and track centers determined, to then define the frog angles so that the radius of the turnouts will be large enough to allow the cars to pass from tangent to curve and curve to tangent with a minimum of effort and with a minimum of shock, as mine cars are usually heaped up with coal. With an improperly designed crossing this heaped up coal would jar off the cars. Also, with the foregoing in mind, the aim is to retain as much space as possible for coal storage, which is lost by making the crossover too long.

THE AUTOMOBILE TESTING PLANT OF PURDUE UNIVERSITY.

Purdue University, at Lafayette, Ind., has installed an automobile testing plant. The design of the plant has been worked out under the general direction of W. F. M. Goss, Dean of the Schools of Engineering, assisted by Professors J. R. McColl and W. O. Teague, and follows lines which are similar to those of Purdue's locomotive testing plant. It constitutes a mechanism upon which an automobile of any type, whether steam, electric or gasoline driven, may be mounted and operated. When thus operated the power delivered and the efficiency which marks the action of the machine may be determined. An elevation of the plant, with an automobile mounted for testing, is shown in Fig. 1. The rear or driving wheels of the automobile rest on top of the wide supporting wheels (D), which are mounted on the shaft (E) running in fixed bearings. Thus mounted, the automobile is held in its desired position by a connection with a traction dynamometer, Fig. 3, which in Fig 1 appears at the rear of the machine. A friction brake on the axle of the supporting wheels absorbs the energy delivered by the machine. In addition to this equipment, a motor-driven pressure blower is provided to deliver air through adjustable piping for cooling the radiators of steam and gasoline machines; also a motor-driven exhauster takes air from a point near the exhaust of the machine, thereby freeing the laboratory of obnoxious gases.

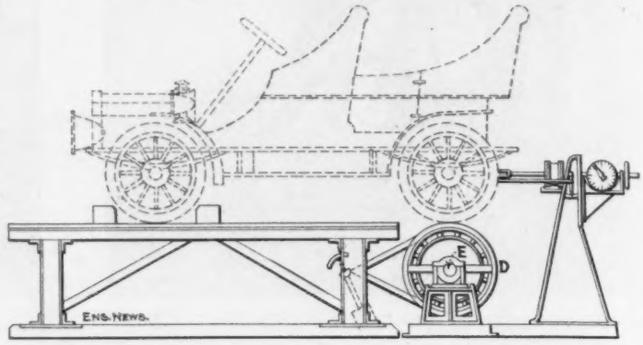

FIG. 1. AUTOMOBILE TESTING PLANT OF PURDUE UNIVERSITY.

Concerning the theory of action, a glance at Fig. 1 will make clear the fact that if the supporting wheels (D) were blocked so that they could not turn, the automobile would, if started, tend to move forward with its full tractive power, even to the extent of slipping its driving wheels upon the supporting wheels. Its tendency to move forward in this case will be registered as a pull upon the dynamometer. If, on the other hand, the supporting wheels are frictionless upon the turning of the driving wheels of the automobile through the action of its machinery will not result in any pull upon the dynamometer; for if frictionless, the supporting wheels can offer no reaction for such a pull. The supporting wheels are, in fact, neither blocked nor frictionless, but the design is to have them turn against a resistance the value of which may be varied at will. The arrangement is such that whatever this resistance may be, it appears as a stress on the draw-bar. The resistance is regulated by means of a friction brake, Fig. 2, to which reference has already been made. By its adjustment, the load on the automobile, which varies with the pull upon the dynamometer, may be varied as desired. In all cases the energy delivered by the automobile is the product of the pull exerted at the draw-bar, into the distance passed over by the tread of the driving wheel. Thus the horsepower delivered is equal to the pull upon the dynamometer in pounds multiplied by the space passed over in one minute by the automobile driving wheel as measured on the supporting wheel on which it runs, divided by 33,000. The space passed over is most conveniently found by determining the number of revolutions of the supporting wheel and multiply by its circumference. This method will eliminate any errors due to lack of uniformity in the rubber-tired wheels of the automobile or any slippage which may occur during the test.

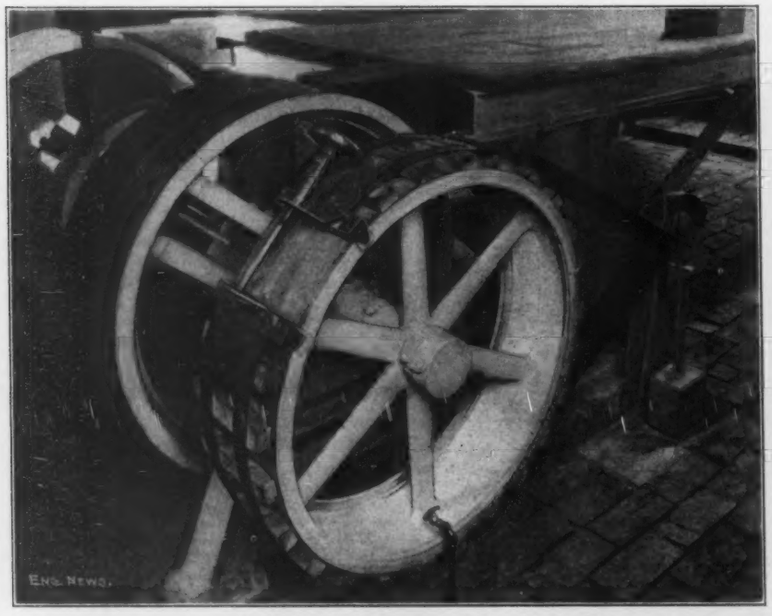

FIG. 2. FRICTION BRAKE USED ON AUTOMOBILE TESTING PLANT.

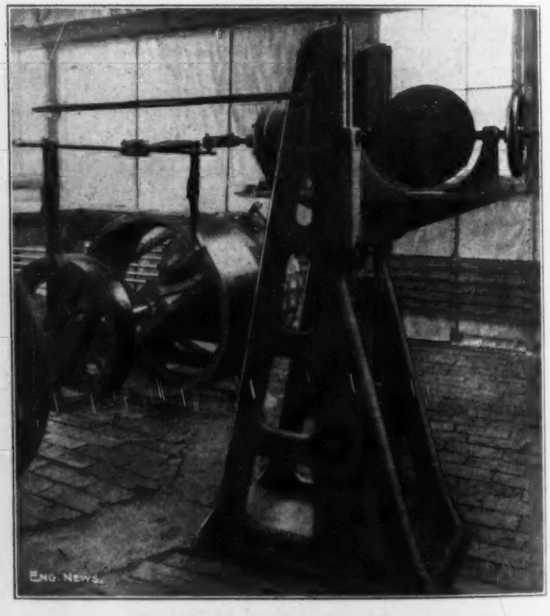

FIG. 3. TRACTION DYNAMOMETER USED ON AUTOMOBILE TESTING PLANT.

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An excellent general review of the present status of sewage treatment is given in other columns of this issue in the form of an address by Mr. Geo. W. Fuller. In the course of his rational presentation of disposal by dilution, the subject of shellfish and typhoid fever is briefly discussed, and it is suggested that the problem is one of balancing "the relative financial importance of the shellfish industry and of the purification of the sewage." Obviously it might be cheaper for a community to buy out and cause the abandonment of oyster beds than to purify its sewage so as to free the latter from danger; while in other cases such a course would be financially impracticable.

The relative positions of sedimentation, septic treatment and chemical precipitation, are clearly put by Mr. Fuller, who shows that each is merely a preparatory process, where high reductions of either organic or bacterial contents are desired, and that the septic tank, in particular, falls far short of popular estimates. This is not saying that the septic tank may not often be of great service, and under some conditions almost indispensable.

One hint given by Mr. Fuller is well worth careful consideration by engineers, and may yet lead to a marked departure from present methods of sewage treatment. It is that where a high degree of purity is desired, contact beds or percolating filters, when on a large scale, be supplemented by mechanical filters, much as the latter would be used to treat a polluted and turbid river water. Years ago, we may add, a representative of one of the companies engaged in building mechanical filters said to the present writer that his company would soon be installing mechanical filters for sewage treatment. But the patent litigation or other complications that soon came on possibly explains why this, like some other plans of the old-time filter companies, failed to materialize. In the years that have ensued since the remark mentioned was made, far-reaching improvements in mechanical filtration have been effected. For our part, we should like to see a practical trial of mechanical filtration for the effluent from both contact beds and percolating filters, but particularly from the latter. Where land is valuable, and a natural filtering medium not readily available, and where enough sewage is to be treated to warrant the use of mechanical apparatus and the employment of skilled attendants and a technically trained superintendent, there seems good reason to believe that a combination of percolating and mechanical filters might result in both economic and sanitary efficiency. Moreover, if some of the British claims for percolating filters hold good in practice, or perhaps we should say after more extended trials, a combination of percolating and mechanical filters, perhaps with limited intermediate sedimentation, with or without coagulation, might stand a good chance of success. Another possibility, under special local conditions, is the combination of chemical precipitation, much as now practiced, with subsequent mechanical filtration; but in the light of past experience and present tendencies, this is far less likely of adoption than the suggestion made by Mr. Fuller.

A serious loss of property and possibly of human life in the recent Windsor Hotel fire at Montreal, Canada, was prevented only by the heavy fire walls which separated the guests' rooms from the other parts of the building. The newspaper accounts of the fire are rather meager in facts relating to the structural details of the building, but it appears to have been divided into three parts by substantial fire walls reaching from cellar to roof. As a result the fire, which originated in the center section and completely gutted this portion of the hotel, containing all the public rooms, did not spread to the side sections, and not only did the guests have ample time to escape with all their belongings, but the property damage in these sections was comparatively insignificant. It is quite evident that both owners and guests have to thank the fire walls alone for their escape from danger. If it had not been for them, the stories of the Windsor Hotel fire in New York City, in March 1899, and of the recent West Hotel fire in Minneapolis, Minn., would very probably have been repeated at Montreal. However this may be, it cannot be too often pointed out that one of the most efficient safeguards against fire danger in buildings of large area is a brick fire wall with a minimum number of openings and these closed by fire-resisting doors or shutters.

CONCERNING FRAUDS IN THE PUBLIC LAND SURVEYS.

Is the system of public land surveys honestly and efficiently conducted at the present time? Engineering News submits this question to its readers, who are as well able to give an answer from personal knowledge as any class of men that could possibly be found.

That great and serious frauds have been common in the Government land surveys in past years is well known to engineers, and is, in fact, freely admitted by the Government authorities. Elsewhere in this issue we publish a contribution from an engineer who is an entirely competent judge and who has no personal motive to serve, in which a concrete illustration is given of a fraudulent Government land survey, or, rather—to call things by their right names—of a case where the Government paid for surveys which were never made.

As our correspondent points out, and as every reader of Engineering News well knows, the injury done by these false and fraudulent Government surveys falls not on the Government itself, but on the settlers who purchase land in a new country and find the titles to their homes and farms involved in doubt. These defective and fraudulent surveys benefit, and are not seldom intended to benefit, the speculator, the land-grabber and the shark attorney, and they work an enormous injury to the honest and law-abiding public.

It is undoubtedly true that the character of the surveys made at the present day is very much better than formerly. When the whole matter of the surveys was left to the Surveyors-General, corruption was rife and the office was made in too many cases a center of dishonest practices. For some years past, however, all public land surveys have been inspected by official examiners of surveys selected under civil service rules and reporting directly to the Land Office at Washington, and this has undoubtedly resulted in a large measure of improvement.

Nevertheless, we are strongly inclined to the belief that the present method of conducting the Government land surveys through the Surveyors-General, who are appointed through political influence, is radically and inherently wrong, and does still result in more or less inefficient work in this important Government department.

Let us take for illustration the very striking fraudulent survey in Northwestern Wyoming, which is described by our contributor in this issue. The Government surveying in this section was so radically defective, we are informed, that settlers are fortunate if they find as many as three monuments in a township. This fraudulent work was done by a Californian named Benson and his associates; and resulted in the indictment and trial of Benson, who was, however, acquitted. But the contracts for Government surveys in that section are still awarded, we understand, to survivors of the Benson parties; and one reason for this is found, doubtless, in the fact that the man who was chiefly responsible for many of these original surveys is chairman of a Republican County Committee. He is able to secure the most profitable contracts for himself through dummies working for him.

Such evils as this and worse are certain to continue as long as the office of Surveyor-General is made a political plum and is left in practical control of the award of contracts for land surveying. We doubt whether any remedy will be found effective short of wiping out the whole contract system of land surveys.

And why should not the Government do this? Why should not the survey and subdivision of the public lands be as efficiently and economically done by engineers employed directly by the Government, as is now done by the topographical division of the U. S. Geological Survey? It may be argued that such a change would increase the cost of the work to the Government, but this fact has yet to be established. On the contrary side, we are informed by a very competent authority that the entire State of Wyoming could have been accurately surveyed and well monumented for less than half the money that has already been expended if the work had been done directly by competent engineers in the Government service instead of by the contract system.

There is another aspect of this matter that is worth the serious attention of the engineering profession. The rectangular system of subdividing the public lands and the making of these subdivisions with solar compass and chain was admirably adapted to the level prairie regions of the Mississippi Valley and to the engineering methods and appliances of a half century ago. But it is very poorly adapted to the rough and broken topography of great sections of the Rocky Mountain regions. Here rapid, accurate and economical work demands that triangulation be adopted to supplement the time-honored methods of the public land survey.

There can be little doubt that if the work were to be done directly by the Government, instead of being farmed out to local land surveyors, as at present, up-to-date methods would be introduced in the interest of accuracy and economy.

The whole matter is one of much interest and importance to the engineering profession, and we invite discussion upon it by those of our readers who are in a position to speak from positive knowledge.

THE PROSPECTS FOR CONTRACT WORK AT PANAMA.

Great interest has been excited in the question whether the canal work at Panama would be done by contract or directly by day labor by the Government. Some evidence as to the policy of the Canal Commission in this matter is afforded by the speech of Chairman Shonts, delivered before the Commercial Club of Cincinnati, on Saturday evening, Jan. 20. We quote from it as follows:

> As I said at the beginning of these remarks, our preparatory work is nearing completion. It has, in fact, advanced as far as we can carry it safely until we know definitely the type of canal we are to construct, whether it is to be sea level or high level. It is of the utmost importance, therefore, that decision as to this type be reached at the earliest possible moment.

Whatever may be the type decided upon, it will take us but a short time to complete the arrangements for beginning at once to carry its details into execution on a comprehensive scale. We shall divide the work into sections and prepare specifications asking for bids for contracts for such portions of the work as we think can be done advantageously in that way. We are strongly in favor of doing the work by contract if the type of canal and the prices bid will permit. One of the chief benefits we have derived from the preparatory work is the accumulation of knowledge as to the nature of material to be handled and the cost of handling it, which will enable us to judge whether or not such bids as we may receive will make it desirable to have the work done by contract.

Before any contractor can bid intelligently or safely on the work at Panama, however, the vexed question of labor must be settled. Under the present situation the contractor who bids on work at Panama would be limited to an 8-hour day, and would be beset with exactly the same difficulties in obtaining labor that the United States is now experiencing. These difficulties are so serious that it is hard to see how a contractor at the present time can safely bid on work at the Isthmus involving any considerable amount of labor. The situation is briefly summed up by Mr. Shonts as follows:

> The character of labor employed on the Isthmus has more to do with the time it will take to build the canal—more to do with the cost of construction—than any other determining factor.
>
> There is no insuperable difficulty in the way of the construction of the canal from an engineering point of view and with any ordinary class of labor. The serious problem is to get what will be considered in this country anything like an ordinary class of labor. In examining this question we have studied and discussed the merits of labor of nearly all nationalities available for the purpose.
>
> The chief difficulty with which we have to contend in the employment of Oriental labor lies in the laws which hedge about its use. In order to comply with the letter and spirit of these laws, the best that we can do is to let out the work by contract, advertise and secure the lowest bidder, who will be nothing more or less than an agent. He will secure the labor, deposit the money required by the government of the country from which the laborer comes for the sustenance necessary to the support of his family while he is away, and advance the money for the necessary transportation. All this is to be included in the cost of the labor delivered on the Isthmus, in addition to the agent's remuneration, making it very high priced. The Government must protect itself against the charge of forcing involuntary servitude, and hence it can adopt no safeguards which will prevent the labor from leaving the Isthmus the day after arrival, thus losing the money necessary to get it there, with no return whatever. The result of this is practically to make Oriental labor prohibitive in the construction of the canal.
>
> Experiment with Italian laborers, while not made on a large scale, has not been satisfactory, for the reason that they do not seem possessed of great vitality, and succumb quickly to tropical fevers.
>
> The West Indian negro that we are using has but little life and ambition in him. We are practically trying to wield an inert mass, with the result that we are not getting over 25%, or, from a most liberal point of view, 33⅓% of the efficiency of the most ordinary labor in the United States. We are now arranging to experiment with 1,000 laborers from the north of Spain. This class of labor was used to great advantage by Sir William Van Horne in the construction of his 350 miles of railroad in Cuba. While not tall, they are of muscular build, docile in temperament, and willing and industrious workers, with enough ambition to want to become subforemen and foremen in their work. In other words, besides being laborers they have a spark of ambition which makes it possible to develop them into something better than brute force. These men have the further advantage of being white, and of speaking the language which most of our foremen either know or rapidly acquire after reaching the Isthmus.

Elsewhere in Mr. Shonts' speech he stated that the Government is now paying to its ordinary laborers at the Isthmus 80 cts. to $1.04 gold per day of 8 hours. As these men are not more than ¼ to ⅓ as efficient as American labor in the temperate zone, this means that common labor at Panama is costing from $2.50 to over $4 for such a day's work as contractors in the United States are accustomed to get from their men. Moreover, this does not take account of the expense of securing these laborers, protecting their health and caring for them in illness.

The question comes, How could the contractor do any better than the Government is doing? Labor from the United States appears to be out of the question. There are not enough laborers here to supply the home demand; and even if there were, only a very small percentage of our workmen here could perform effective service in the tropical heat of the Isthmus. The contractor must seek his workmen, therefore, either among the Chinese or Japanese, the nations of Southern Europe or the West Indian negroes that form the present labor force. Doubtless the best solution of the labor problem would be the importation of Chinese; but political prejudice stands in the way there, and while the necessities of the case may yet force Congress to permit the use of this class of labor, this certainly could not be expected if once the work were let to contract where the burden of finding the labor would fall on the contractors and not on the taxpayer. Again, if the Government continues to do the work with its own forces, the 8-hour law may be abrogated, so far as it applies to the Isthmus; but if the burden is shifted to contractors, all chance of removal of the 8-hour restriction will be gone.

If Congress instead of spending time trying to uncover some mare's nest at Panama, would promptly enact legislation abolishing the 8-hour law in work on the Isthmus and permitting the use there of the best labor that can be secured, from whatever quarter of the globe it comes, the opportunity would then be open to let contracts at Panama on a basis that would be fair to the Government and safe for the contractor.

LETTERS TO THE EDITOR.

The Ventilation of Subway Tunnels.

Sir: To those who are honestly striving to remedy the evils due to the almost total lack of proper ventilation in the New York Subway system, I would respectfully call their attention to your statements contained in Engineering News of Dec. 29, 1904, p. 598, and also the timely data contained in the Eleventh Annual Report of the Boston Transit Commission just published.

Very truly yours, J. Calvin Locke.

748 Marcy Ave., Brooklyn, N. Y., Jan. 15, 1906.

(The article referred to described the ventilating conduit constructed in the East Boston tunnel. The Report referred to states that the three ventilating chambers each contain two "Woodbridge centrifugal fans direct-connected to 580 volt D. C. motors. The two fans in each chamber together have a maximum air delivery of about 45,000 cu. ft. per minute, sufficient to change the entire air in the tunnel under the harbor every 15 minutes and in the section under State St. every 13 minutes.—Ed.)

Vibrations in Large Gates for Deep Reservoirs.

Sir: The letter published in the Engineering News of Jan. 11, 1906, discussing the cause of vibration in large reservoir gates calls forth the following observations:

The oscillations in such structures are produced by the varying impact of the moving water, which is due to the pulsations of flowing water. It is a well-known fact that water flowing in channels, whether natural or artificial, moves in impulses. (See U. S. Geological Survey Water-Supply and Irrigation Paper No. 95, "Accuracy of Stream Measurements," by E. J. Murphy.)

It needs but a few observations with a current meter to disclose the fact that the higher the velocity of the water the greater are the varying intensities of the impulses. The same phenomenon is common to the motion of air, and the same characteristic vibrations are noticeable in properly exposed boards and the like in the wind.

Very respectfully, F. W. Hanna,
Engineer, U. S. Reclamation Service.

1333 Park Road, Washington, D. C., Jan. 13, 1906.

Designs for Current-Wheels Wanted.

Sir: Could any of your readers tell me the best way of utilizing a current or rapid or a waterfall with small head for the purpose of raising water? My own idea upon the matter is to use either a stream-wheel mounted on a sort of pontoon and anchored in the river so as to rise or fall with it, or a wheel encased in a kind of box, or else a turbine-like construction sunk into the stream. To this would then have to be attached the pumping machinery, or else the apparatus might be made so as to combine power and pumping machinery in one construction. I should mention that the water would have to be raised to heights of 20 to 200 ft., that the rivers are shallow in most parts, with no great falls but with numerous rapids and small cascades up to 2 or 3 ft. in height, and with a flow of water in the stream I have in mind, of five to ten million gallons a day at low water. As the country (Zululand, South Africa) is subtropical, with wet summers and dry winters, the discharge varies enormously; also the rivers, especially in summer, carry great quantities of mud and sand. I shall feel grateful for your valuable opinion on this matter.

L. M. Allen.

Eshore, Zululand, Dec. 5, 1905.

(Very little has ever been done in a practical way toward the development of very low head water-powers, with exception of the very primitive apparatus used in rural districts at the period before the invention of the steam engine. Old treatises on "natural philosophy," as it was then called, used to contain illustrations of undershot water-wheels and breast wheels, and they were of much practical importance when the winds and falling water were the only powers of Nature available for use.

For small streams with permanent beds, probably nothing better than a reproduction of these old-type water-wheels could be made to-day. For larger streams subject to torrential floods, the problem is much more difficult. Current wheels mounted on pontoons have been used in some places in the West. A plant on the Snake River, Idaho, was described in our volume for January-June, 1903, p. 36. One plan which has been used with success is to attach paddles or floats to an endless sprocket chain running over a sprocket wheel at one end of a pontoon. In our volume, January-June, 1903, p. 234, the use was suggested of a pontoon moored at an angle to the current and carrying a shaft with blades like those of a screw propeller.

It must be borne in mind that any water-power plants for very low heads must almost inevitably develop a very small amount of power, compared with the ordinary type of water-power. Nevertheless, for isolated locations, where fuel for steam raising purposes is hard to obtain, such small plants may be of considerable importance in connection with various lines of industry.—Ed.)

The Type of Canal to be Chosen at Panama.

Sir: Mr. Hall's historical review of the Panama Canal, in recent numbers of Engineering News, is quite a welcome addition to the literature on the subject to those who have but recently taken some interest in the matter.

That the several commissions appointed to investigate the canal question were not more harmonious in views as to the most suitable type of canal is probably due to the difficulty of judging properly the relative importance of its various features. Not only are the investigators confronted by actual facts, but also by the unknown quantities of the future. Besides, if a man knows that his name will go down in history with the possibility, that the future might show an error of judgment on his part, he may be inclined to prefer certainty to uncertainty in regard to such ills as might interfere with the operation of the canal or cause prejudice against it.

As Central America is one of the most favored sections of the earth for future seismic disturbances, on account of the change in direction of the ocean currents on both sides, an earthquake on the Isthmus of Panama cannot be called an unforeseen event. Yet no more serious distortions of the crust than the usual surface cracks can very well be taken into consideration. While a sea level canal probably would not suffer great harm from an earthquake, the damage caused to a multiple-stage fresh water canal would be apt to be more serious and to cause a long interruption to the traffic.

Another, and still more important factor is that the canal has to take care of the traffic not only at the locks, but along the route. The heavier the traffic the greater will be the discharges from the vessels passing through. Strict regulations with regard to refuse may be made, but they may not be so strictly enforced. Their enforcement is dependent chiefly upon human will and energy, which are qualities not to build on too much within the Tropics. Besides, owing to the arrangement on board ships there will necessarily be discharges into the canal, and they might at times be of not very salubrious character. A fresh water canal, not only favors the growth of objectionable vegetation, but also the breeding and spreading of germs of diseases that may be absorbed from such discharges, and should the canal once become a pest hole, a great reduction in the

revenue would no doubt result. There is nothing that could give the canal a greater advantage from a sanitary point of view than great facilities for changing the water in the whole canal at any time it may be desired and the unlimited water supply of the sea and the tide may, and should be made to serve this purpose.

The conditions under which the canal has to be operated are, as stated by Mr. Hall in his review, a variation in sea level of 2 ft. at the Atlantic end and 12-18 ft. at the Pacific end. An Atlantic mean sea level canal proposition with a lock at the Pacific end, is thus very tempting at the first glance. On account of the great cost of excavation for such a canal, proposals are made to build the canal in sections, with several stages of water, locks between each stage, and a permanent reliable water supply to replenish the water in the upper stage of the canal that is lost by locking and leakage. Estimates seem to show, that such canals can be built at a cost considerably below the cost of an Atlantic mean sea level canal. Disregarding, however, the question of cost, a comparison between the proposed canals—the Atlantic mean sea level canal and the multiple stage fresh water canal—will make clear, that the Atlantic mean sea level canal possesses the following advantages over the other types:

(1) Sea water for canal use.

(2) Less chances of stagnant water, thanks to an unlimited supply to draw upon for changing the water in the canal.

(3) In case of a crack through the canal embankment, due to an earthquake, the canal would not be liable to be laid dry.

(4) In case the land should be raised a few feet by an earthquake it would be an easy matter to build a lock at the Atlantic end of the canal to restore to the canal its former depth, and the canal would then become a two-lock canal, yet still be possessed of a good head at the Pacific end for changing the canal water.

(5) At every twelve hours there is a period of time when the locks at the Pacific end may be left open for accumulated traffic to pass through without locking.

(6) The canal may be made into a carrier in either direction by leaving the locks open at the Pacific end.

(7) It would require the least time to pass through. (One lock limits the capacity of the canal, if the other locks are of the same size, but the number of locks governs the time of passage.)

(8) Smaller liability to harm by any other agents of destruction than earthquakes.

(9) Independence of a water supply that might fail from unexpected causes.

(10) Great simplicity of operation.

(11) Smaller cost or maintenance.

(12) Future expenses for repairs, other than those for ordinary maintenance, not liable to be so high, as those for a multiple stage fresh water canal.

The diversion or regulation of the Chagres River, which river interferes with the construction of a canal of any type, naturally forces itself upon the attention of those who have to study the canal question. It is a problem by itself, apart from the canal, in the case of the Atlantic mean sea level canal, while in the case of the other canal propositions, it is an important part of the whole, and, at that, subject to both natural and created uncertainties.

Mr. Hall's proposition of a canal at the maximum high water level of the Pacific Ocean at Panama is somewhat similar to the Atlantic mean sea level canal. Its level is higher, and, therefore, necessarily requires a lock at the Atlantic end in addition to that at the Pacific. This canal can be changed into an Atlantic mean sea level canal temporarily, if desired, at a sacrifice of some of its depth, by lowering its level, and opening the lock gates at the Atlantic end. This canal has also the character of a 2-stage fresh water canal at the maximum high water level of the Pacific at Panama. It seems to be a cross between the two types. Its smaller cost than the Atlantic mean sea level canal, on account of less depth of excavation, is certainly in its favor—particularly at the maximum high water level, but if its level be established at the minimum high water of the Pacific at Panama, in order to obtain occasionally a head of water there, the additional few feet of excavation (about 6 ft. in depth of section) required for the Atlantic mean sea level canal, may not outweigh the advantages possessed by the Atlantic mean sea level canal. It would amount only to a few per cent. of the cut at Culebra, but on lower ground, of course, the percentage would be higher.

By comparing diagrams of the proposed canals, it will be seen:

(a) That the multiple stage fresh water canal system will depend on its own supply—the reservoir and its source—for its needs, and, if the supply be ample, a continuous movement of the water may be had, and the movement will be toward both ends of the canal at the same time.

(b) That the Atlantic mean sea level canal may receive during the entire high water period in the Pacific, a continuous supply of sea water, and that, in case of necessity, the lock gates may be left open during this period, suspending in the mean time the traffic, when a movement of water through the canal may be obtained, that will, after some repetition perhaps, entirely change the canal water in a very short time. This advantage becomes more conspicuous, if a thought is given to the question of cleaning the canal bottom. (The movement of the water, due to locking, will be in one direction during the high water period, and in the opposite direction during the low water period, and thus practically have no effect in changing the water.)

(c) That in the canal at the maximum high water level of the Pacific at Panama, there can be no movement of sea water in any direction under ordinary circumstances. The loss by locking, leakage, and evaporation must be replaced from some reservoir, presumably supplied by the Chagres River. The movement of the water will be toward both ends of the canal. Thus it seems that this canal will be changed into a fresh water canal, if in continuous operation, even if starting out as a sea water canal. Transformed into an Atlantic mean sea level canal by lowering its level, and opening the gates at the Atlantic end, its water may be changed as conveniently as it is done in the case of that canal, should it become necessary to draw water from the sea. The traffic, though, would have to be suspended for a longer time.

If the waterway should be considered as a strategic advantage to the United States, the fewer vulnerable points it would have, the better, and the locks certainly would be weak spots in the canal system, if it ever become of real strategic importance in time of war. Yet, the strategic advantage that would be derived from the canal favors to some extent the canal proposition, that could be most speedily realized, which already both climatic conditions and costs do.

Yours respectfully,

E. R. T. Berggren, M. E.

32 Park Place, New York, Jan. 10, 1906.

(We do not recall that anyone has previously raised the question of possible pollution of water in the Panama Canal; but it must at the same time be said that, so far as we can see, it is a question of no importance whatever. Our correspondent speaks of the discharges from ships. Many people have a totally wrong conception of the future traffic at Panama, as if there were to be a continuous procession of ships like the trains on the Manhattan Elevated R. R. The fact is that the probable future volume of the Panama traffic has been very carefully studied, and it appears as certain as anything can be that the traffic volume will be considerably below that of the Suez Canal, through which there now passes a traffic of a little over 3,000 vessels per annum, or less than ten vessels per day, counting traffic in both directions. The pollution produced from the discharges from such a number of vessels would be infinitesimal. It has never caused any trouble at Suez, and there is no reason whatever to suppose it would ever cause any trouble at Panama. If any importance at all attaches to the matter, then it would be an argument in favor of the lock canal, in which the water would constantly be changed by the amount used for lockage, while a sea-level canal will be as stagnant as any bayou in a tidal swamp not fed by fresh water.

As for our correspondent's idea that salt water is better than sea water for a ship canal, it has always been held, on the contrary, to be a great advantage for ocean vessels to pass into fresh water to kill the barnacles and other marine growths on the hull.

As for the earthquakes, we cannot do better than to quote from the report of the Isthmian Canal Commission of 1901:

> The locks will all be founded on rock. It does not seem probable that works of this kind are in any serious danger of destruction by earthquakes, in a country where lofty churches of masonry have escaped with a few minor injuries. . . . If a timorous imagination is to be the guide, no great work can be undertaken anywhere.

As for vulnerability to the attack of an enemy, a sea-level canal can be almost as easily obstructed as a lock canal. A great dam for controlling the Chagres is necessary for either plan. The sea-level canal will be for a long distance a ditch, with its bottom 50 to 80 ft. below the level of the country and river diversion channels on either side at a higher level, separated only by a narrow embankment.—Ed.)

What Should Properly be Included in the Subject of Railway Economics in a Civil Engineering College Curriculum?

Sir: The writer has spent a large part of his time for the last five years in preparing and teaching a course in Railway Economics and he feels very great interest at the present time in getting the views of practical engineers and railway managers as to what the subject should properly embrace as taught in undergraduate engineering schools. The writer has had extended correspondence of a personal nature on the subject with practicing engineers and engineering teachers in various institutions; but the criticisms thus received have been so flattering to his own ideas that he fears that they have been softened too much by personal considerations. He had thought of preparing a paper on the subject and offering it for discussion to the Society for the Promotion of Engineering Education. But the views thus secured would necessarily be rather from an academic standpoint, while the principal object desired is to obtain opinions on the subject from impartial practicing engineers and educated railway men.

Mr. A. M. Wellington was probably the first prominent engineer who brought into general use the term Railway Economics in connection with his well-known book on the "Economic Theory of Railway Location." As Mr. Wellington viewed the subject from an engineering standpoint he considered that the subject should treat entirely of the bearing that the layout of a new line or the improvement of an old line, has upon the revenue of the road. Mr. Wellington's view was one taken principally in the interest of the stockholder.

But other writers take an entirely different view as to what the term Railway Economics should signify. Mr. H. T. Newcomb, the well-known railway writer and statistician, published a little work in 1898 under the title of "Railway Economics." In the preface the author tells us that the book was written "to present the principal facts which establish the position of railway transportation in the present organization of industry in the United States . . . ." The work is concerned with an historical account of the development of railway transportation and touches upon the subjects of Discrimination, Consolidation, Pooling, Taxation, etc. Little is said about the question of how to regulate railways so that they will be operated in the interest of the public that they serve as well as in the interest of the stockholders that own them. The great problem of 1904 and 1905, the control of the railway rate, had not arisen in 1898.

Early in 1903 Mr. Walter Loring Webb, formerly Assistant Professor of Civil Engineering in the University of Pennsylvania, revised and recast his work on Railroad Construction, putting it in pocket form. Part II. of this second edition consists of just 100 pages and is entitled "Railroad Economics." After the introduction the chapter headings through this part of the work are entitled: "The Promotion of Railroad Projects," "Operating Expenses," "Distance," "Curvature," "Grade," and "Improvement of Old Lines." A student can read through these 100 pages without ever learning the principle upon which freight rates are based, or without learning the fact that the laws of the land provide that state and national legislatures shall have great authority over railway operation and charges.

The next author with a book on Railway Economics is Mr. W. M. Acworth, of England, who published "The Elements of Railway Economics" early in 1905. The work is extremely brief and is confessedly incomplete, being what the author calls only an installment; but it is probably the best work for engineers yet written which includes a discussion, as applied to English railways it is true, of views on railway regulation by government authority. The object of the work, the author says, in the first lines of the first chapter, "is to consider railways and railway business from the economic point of view." The view point of Wellington and Webb is entirely lost by Mr. Acworth. In his view the railway is already constructed and improved and has become the chief means of transportation and intercommunication. The principal question Mr. Acworth deals with is how the railway should be regulated and operated so as to render it primarily as fair and serviceable as possible to its patrons, and, secondarily perhaps, how to make it as profitable as may be to its owners. Mr. Acworth discusses most interestingly the subjects of railway capital, income, expenditure, the bases of freight rates, freight classification and government regulation.

Other interesting writers have dealt with these same subjects under different titles. Among such works that an economist or graduate engineer student can peruse with profit are Adams' "Railway Problems," Stickney's "Railway Problems," Jeans' "Railway Problems," Hadley's "Railroad Transportation," Johnson's "Railway Transportation," Meyer's (B. H.) "Railway Legislation," Newcomb's "Facts About Railroad Rates," Haines' "Restrictive Railway Legislation," Meyer's (H. R.) "Government Regulation of Railway Rates," and Noyes' 'American Railroad Rates." Of course, a student working up the subject thoroughly could not neglect much other col-

lateral matter; various pamphlets, such as those of Joseph Nimmo, and various reports, such as those of the Interstate Commerce Commission, the report of the Industrial Commission, as well as the discussions and addresses on these questions that have appeared almost continuously of late years in the technical press.

But none of these books are suitable for even a part of a course in Railway Economics for undergraduates. The problem the writer is trying to solve is what should be included in a work which shall be used as a college textbook by the average student who comes to an engineering school to take the usual four-year course in civil engineering and then expects to enter railway service. The writer proposes the following definition as briefly expressive of the scope of the subject as it should be taught in such a course: Railway Economics is the study of the organization, construction, extension, improvement, condition, operation, and regulation of railways with reference to the public service rendered by them and with reference to the increase of their earning power.

The writer sincerely believes that it is extremely desirable that such a student should have very capable instruction in the broader questions affecting railways. He should understand the obligations to the public imposed upon a railway by the laws of the land by virtue of its being a public service corporation and a creation of the state, as well as the necessity of building and operating the road so as to secure the most returns upon the road's securities. He should be drilled upon the principles of incorporation and the bases of freight rates, as well as upon the money value of eliminating grades, curves, and distances. In short, he should be brought to look upon a railway with some insight into the general purpose of its existence and not simply as a congeries of right-of-way, roadbed, bridges, rails, buildings, terminals, and rolling stock. That this is no new viewpoint in engineering education is proven, the writer believes, by the fact that Wellington's "Economic Theory" was retained so long and so generally as the standard engineering work on this subject in the best engineering institutions. That work discusses railways as they existed previous to 1886. It has certainly been almost entirely out of date for ten years or more, since by that time the various national laws that had been enacted and the various railway consolidations that had been formed had almost entirely changed the status of railway affairs from that which Wellington discussed. And yet this work was retained unrevised as a text-book in Cornell University as late as 1904. The real engineering part of Railway Economics treated of in Wellington's great work of 950 pages has been condensed by Professor Webb into 100 pages of pocketbook form. Seemingly there is no valid reason why this encyclopedic work should have held its place so long in college curricula except that it gave a broad insight into the inside principles and workings that govern a railway, which insight could not be secured by the perusal of any other single work and perhaps not by the perusal of several works.

If the railway engineering student is ever to become something more than a purely technical railway engineer, dealing with grades, curves, steel and masonry structures, rail sections, low joints, and water service; that is, if he is ever to become something more than a $1,500 or $1,800 a year man, he needs to be drilled upon the obligations of a railway as a public service corporation and also upon its rights as a private corporation. There can be no doubt but that in the future the railway is going to be held to a much stricter accountability to its public obligations than it has been in the past. And the old time railway official, who attempts to browbeat the public is going to be at a discount. A prediction may well be justified that the successful railway manager of even the very near future is going to be a finished gentleman rather on the student order than of the burly, grizzled, man-driving type which accomplished such excellent results under past regimes. Mr. Cassatt and Mr. Mellen are types of men very far removed from the sturdy old railway giants of past eras. The railway manager in Chicago whose system has increased its earnings in largest ratio in the last seven years is a most earnest student, and in his younger days helped to devise the form of rail section that is now used by a great majority of our railways.

The writer knows from observation and some experience that the average engineer who enters young the service of a railway, who becomes well used to implicit obedience to the instructions of his superiors and to having his own instructions likewise observed by contractors and his own inferiors is likely to absorb very greatly warped views in regard to the public obligations of the great corporation that he serves. He grows to take great pride, as he should, in the success of his company and oftentimes greatly overrates its importance. When the interest of the public and that of his corporation conflict, he comes sincerely to believe that his corporation cannot back down and that public interests must and should give way. When this engineer has become an executive officer of the company, instead of trying to arrange his train schedules and his freight facilities so as to render the best and most convenient public service possible he is disposed to say to the public that if it cannot accept the service he proposes to offer, it can walk and haul its freight with an ox team.

There is no doubt that in future, however it may have been in the past, the less there is of such a spirit among railway managers and employees the better will be its prospects for dividends. And there is no doubt in the writer's mind but that the best interest of the railway will be best served if its educated employee enters its service with well formed ideas at the beginning of the actual relative importance of the company he is serving and of its obligations as a public servant. Otherwise it will very probably in the future cost his corporation dear to correct his misapprehension.

It is true that there have been many overt sneers at the so-called "academic" view of railway affairs and conditions, but there is no doubt but that far more comprehensive and correct views on railway geography, traffic and service can now be secured by a few months' study at the best institutions of learning rather than by work in the service of some great corporation. There are probably no railway men in the United States to-day who are better informed on railway subjects than the two Professors Meyer.

It is not argued here that the day has yet come when any railway in the country could profitably employ two such men as these, without practical railway experience, as vice-presidents in charge of traffic, but it is true that the railways of the country would hardly be facing such adverse legislation to-day if railway traffic men had been influenced to a somewhat greater extent in former years by a keener realization on their part of the obligations of their companies as public service corporations.

An English railway manager said in effect in an address to his own employees a little more than a year ago that the supreme test of the success of railway management was the efficiency of the public service rendered. The railroad that serves best should be best paid and will be. In the United States we are rapidly approaching the time, if, indeed, we have not already reached it, when railway employees and managers must perforce adopt this point of view.

Among the most frequent criticisms of his ideas that the writer has encountered has been that though it is true that such students should have training in these subjects they are not properly engineering subjects and should be taught in departments of Political Economy. That is precisely what the writer believes should not be done. We long ago concluded that mathematics should be taught to engineer students by an engineer teacher, and the writer believes that both the economic and the engineering side of Railway Economics can best be taught to engineer students by engineer teachers who have had some years' experience in the service of a first-class railway. Railway engineering subjects are now taught in nearly all of our better institutions by engineers who have had more or less practical experience in railway service. The writer submits the assertion that with no more time given to the subject of Railway Economics than the old curricula gave to Wellington, say, three hours a week for half of the Senior school year, a fairly comprehensive course, including both the so-called economic and the engineering sides of the subjects, can be given.

The so-called engineering part of Railway Economics can be put in very brief form and is quickly and easily comprehended by advanced students. A large part of the substance included in Mr. Webb's 100 pocket-size pages of "true engineering matter" relates to subjects which Wellington carefully classified as "The Minor Details of Alinement."

While the writer appreciates to the fullest the value of the great work done by the departments of Political Economy in our best institutions, he believes there is an inherent difficulty in having such departments teach these subjects to young railway engineers. As such departments are at present organized in most institutions, there would be danger that the engineer product of their schools would have an unpractical set of mind that could see little that was good in present railway conditions. Besides, many of the teachers in these departments are somewhat wanting in practical views, having never battled at close range with business affairs. However, there are a very few institutions in the United States the product of the Political Economy Departments of which the writer would be disposed to suspect of having a mental set very similar to that of the man described who gets his training entirely in railway service. Such a man could see nothing wrong in anything that the railway might do. He would believe, as one teacher in the Political Economy Department of the University of Chicago appears to believe, that whatever is in railway service or conditions is best and right.

Now it must be apparent that the mental set of educated railway officers is going to be a matter of very much graver moment in the future than it has been in the past. And the writer believes that it would be equally unfortunate for the average young railway engineer to absorb either the point of view of Senator La Follette, of Wisconsin, or of Professor Hugo R. Meyer, of the University of Chicago. In other words, the young railway engineer student should imbibe an unbiased practical attitude of mind that will best enable him, if he ever rises to positions of authority and responsibility, to so adjust the affairs of his corporation as to comply with both the letter and spirit of its every public obligation and yet secure for it the largest possible returns on its traffic and expenditures. Of all the men in the average college faculty best fitted to give instruction calculated to impart this desirable attitude of mind to railway engineer students, they are the men who have had experience in serving both the public as teachers and the great railway corporations as engineers.

W. D. Taylor, M. Am. Soc. C. E.
Professor of Railway Engineering,
University of Wisconsin.

Madison, Wis., Jan. 15, 1906.

(Our correspondent raises some questions that are exceedingly interesting, but very hard to answer.

Regarding the field covered by Wellington's "Economic Theory of Railway Location," we may note that this work was intended by the author to cover railway economics only so far as it relates to the original location and construction. Further, it was written in the competitive era of railway construction, when railways were projected and built as rivals to existing lines, and when a main object that the railway constructing engineer had to keep in mind was how to build a road that could get business away from competitors. That situation has entirely changed. Railway competition has not wholly disappeared, it is true; but we are sufficiently near its end, and particularly near the end of competitive railway construction to be obliged to take a wholly different view of the railway business from that which was taken 20 years ago.

We agree with Professor Taylor that the young engineer graduate ought to have some instruction in the economic side of the railway business, to enable him to distinguish the true from the false. An engineer graduate is given an education that enables him to identify at a glance the perpetual motion propositions that are all the time brought forward to defraud ignorant investors. Why should the engineer graduate not be similarly trained in economics, so that he can value at their proper worth the arguments spread abroad by the railway press bureaus as well as the lurid attacks on railways aimed by sensational journals?

As to whether this instruction should be given by an engineering professor or by a professor of economics, we should say it was largely a matter of personality. We agree that it would be a decided misfortune to any student to form his ideas and opinions on railway economics under the instruction of Prof. Hugo Meyer, of the University of Chicago; but how many engineering professors are there sufficiently well grounded in modern railway economic science to be competent to instruct their students? Will not this question be settled differently by different institutions, according to the men who may compose the teaching force in different departments. At Yale University, for instance, if President Hadley still gave instruction in economics, the engineering department would be more than pleased to have its students under his training.

Finally, apropos of the suggestions made by Professor Taylor as to sources of information for graduate students in railway economics, let us utter a word of caution. A large amount of matter circulated in the press on the subject of the railways and their relation to the public originates with the organized press bureaus, whose business it is to educate the public as to the railway's side of these questions; and this applies, we have every reason to believe, to some of the men who pose before the public as independent and unbiased economic investigators. We do not say that all the statements thus put forward are false; nor do we contend that the railways have not a right to take this means of educating the public. We do know that caution is necessary in accepting many of these documents. The unbiased student of these problems who seeks for the truth should examine very carefully the matter he finds published in the daily and periodical

press, and satisfy himself that it is of independent and unbiased origin and is not the work of a paid attorney or organ whose business it is to present only one side.—Ed.)

Notes and Queries.

C. H. W., of 45 West 39th St., New York, asks:

Have any tests of the strength of standard beam connections ever been made? If so, where can I find them?

In Engineering News, 1898, II., 43, 203, will be found detailed reports of tests by Mr. James Christie, Mr. G. E. Thackray and Mr. H. S. Prichard, on the strength of standard 6-in. I-beam connections. These originated from Mr. Prichard's contention that the minimum spans for beams and channels as quoted in the rolling-mill handbooks were dangerously low, involving very excessive rivet stresses. We know of no other tests, but will be glad to note any further references which may be called to our attention.

An anonymous subscriber in Buxton, La., who probably omitted to give his name from ignorance of journalistic ethics, asks this question:

Is it good practice to use filler plates under the stiffener angles of plate-girders, or is it better to offset the ends of the stiffener angles to fit the legs of the top and bottom chords?

Practice in this country to-day favors the use of filler-plates under stiffener-angles, leaving the latter straight, i. e., uncrimped. There is no strong reason, of general applicability, for preferring one form of stiffener construction to the other. The straight stiffener is the better, except for the greater length of the rivets; it requires the extra expense of cutting, punching, handling and bolting up the fillers, which is to be offset against the cost of crimping the ends of the angles in the other construction. It is sometimes held that a straight stiffener with fillers is better adapted to receive concentrated loads from the flanges and distribute them to the web, relieving the flange rivets from the high and difficultly-calculable transverse shear. Many plate-girders have been built in which the end stiffeners have fillers, while the intermediate stiffeners, carrying no concentrated loads, are crimped. But it would appear that a crimped stiffener is substantially as efficient as the other in transmitting load-concentrations from the top flange to the web, provided the end of the stiffener is fitted tight against the outstanding legs of the flange angles. This latter is a much more important point than the matter of crimped versus filler construction, in those cases where a stiffener is a distributing angle (i. e., has to take concentrated loads from the top flange). In case of pure stiffeners, which have no function other than to hold the web against buckling, the details of construction are less material. Of course it will generally be advisable to use the same design and workmanship on all stiffeners, whether distributing or merely stiffening in their action. The design would then be governed by the requirements of the more severe service.

ANNUAL MEETING OF THE ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.

The twenty-first annual convention of this society was held at the Nelson House, Rockport, Ill., Jan. 17, 18 and 19, with a good attendance and an exceptionally successful program. In the annual presidential address, Mr. D. H. Maury, of Peoria, discussed the special field covered by local or State engineering societies and their relations to the larger national societies. There is no competition or rivalry between them, but one is the complement of the other.

The report of the Secretary and Treasurer showed: Receipts, $1,410; expenditures, $1,007; balance in bank, $403. The society now has 179 members.

SEWERS AND SEWERAGE.

The report of the Committee on Sewers recommended that a complete sewer system should be planned when a town is first laid out. A paper by Mr. T. S. McClanahan dealt with the theory of sewage purification in septic tanks, and described briefly the sewerage and sewage disposal systems of Monmouth, Ill. The sewage was originally discharged into a stream flowing through pasture lands, with the [alleged] result that the cows became sick, and as the people stopped buying milk the owners brought suit against the city. After paying $700 in the first suit, the city built a septic tank after designs by Mr. McClanahan, at that time City Engineer.

The new sewage disposal plant at Downer's Grove, Ill., was described in a paper by the designer of the plant, Mr. W. S. Shields (Chicago). An abstract of this paper will be given later.

ELEVATED WOODEN WATER TANKS.

This paper was by Mr. H. C. Nicolet (La Salle), and dealt with the failure of a wooden tank at La Salle, Ill., on March 29, 1905. An abstract of this paper is given herewith:

The tank was 30 ft. diameter and 24 ft. high, mounted on a circular stone tower 77 ft. high. At the time of the failure the water was within about 3 ft. to 6 ft. of the top. The tank was built in 1898, and was of Louisiana red cypress, the staves and bottom being 3 ins. thick. The bands were 6 ins. wide and ⅛-in. and $^{3}/_{16}$-in. thick, with the usual spacing. The immediate cause of the failure was corrosion of the inside of the bands. On March 26, the bands near the middle of the tank snapped, and inspection showed them to be badly rusted on the inside faces. The foreman was instructed to keep the tank not more than half full, pending repairs, but the limit was exceeded. The staves broke off about 4 ft. to 6 ft. above the bottom, and all the bands were ruptured except the two at the bottom. The tank had been kept well painted, and the bands had been painted with an asphaltum paint before being applied. The structure was inspected in December, 1904, and showed no sign of distress. As it replaced a tank which had lasted 17 years (and was then removed to make way for a larger one), it seems strange that rust should have so soon caused the failure of the newer tank. The timber also showed decay; the specifications allowed 1 in. of bright sap on two edges of any stave or 2 ins. on one edge; these limits were reached in several instances.

A new tank of the same dimensions was built, but varied in some of its details as suggested by the accident. Round steel rods were used instead of flat bands. There were 29 rods 1⅛ ins. diameter and 6 of 1-in. diameter, spaced from 5 ins. c. to c. at the bottom to 21 ins. at the top. This spacing was arranged to give a tensile strain under static load not exceeding 12,000 lbs. per sq. in. at root of threads. The rods were bent to the proper curve before being put in place, and the joints were made by means of malleable iron lugs. The lugs were squared and faced to remove burrs, and the rods were threaded at each end and fitted with nuts, the threads being kept clean of paint and covered with Dixon's graphite grease. It was expected that the rod hoops would indent the wood considerably when the tank was filled and that they would have to be tightened from time to time. The parts of the threaded rods covered by the lugs are the weak points in the structure, as they are hidden and subject to rust. The lugs are filled with the graphite grease, and these parts of the rods must be treated every few years.

When first filled there were a few slight leaks in the bottom of the tank but none in the sides, and it has not been necessary to turn up the nuts to tighten the hoops. The rods form grooves on top for water and dust to collect, and it would seem to be a good plan to bevel the outer corner of each stave to afford drainage. The cost of the tank was as follows: Woodwork (including freight), $813; steel rods, $230; lugs, $50; paint, $9; machinists and blacksmiths, $45; carpenters and painters, $200; laborers, $10; total, $1,357. Summary: Material, $1,002; labor, $255.

SEDIMENTATION IN RELATION TO DRAINAGE.

This paper was by Mr. J. W. Dappert (Taylorville), and after describing the conditions of erosion, suspension and deposition of silt by large rivers, it dealt with the same conditions as occurring in drainage canals and ditches. Mr. D. W. Mead (Chicago) stated there is now a depth of 10 or 12 ft. of silt against the dam at Danville, the material being largely that which is rolled along the bottom of the stream. One cause of the trouble so often experienced in drainage ditches is that the engineer's plans are altered for financial reasons; the arbitrary changes in grade, dimensions of channel, etc., may have serious results, for which the engineer will be blamed, although he is not at all responsible. In the large irrigation works of the West the silting up of large reservoirs will be a serious matter, reducing the capacity of the distributing system. One of the problems now to be considered is that of preventing this silting. The report of the Committee on Drainage described a number of drainage works in the State, with particulars of cost.

An interesting paper by Dr. Edward Bartow (Urbana), Director of the State Water Survey, is printed an another page of this issue.

THE WORK OF THE ENGINEERING EXPERIMENT STATION, UNIVERSITY OF ILLINOIS.

The engineers of the State in general and the members of the society in particular have taken special interest in this work of the University, and we give below a few extracts from the paper by Prof. A. N. Talbot:

It is planned to have this organization carry on investigations along various lines of engineering, and to study problems of importance to engineers and to the manufacturing, railway, constructional and industrial interests of the State. The work in experimental research ought to give results of much value to the profession. Prof. L. B. Breckenridge (Professor of Mechanical Engineering) is Director, and the following members of the faculty form the staff: N. C. Ricker, Professor of Architecture; I. O. Baker, Professor of Civil Engineering; A. N. Talbot, Professor of Municipal and Sanitary Engineering; A. P. Carman, Professor of Physics; Morgan Brooks, Professor of Electrical Engineering; and S. M. White, Professor of Architectural Engineering. Four assistants are giving all their time to the work, and a number are giving part of their time. Bulletins have already been issued in regard to the results of investigations on reinforced concrete and high-speed tool steel. Work is in progress along various other lines, including the following: Collapsing strength of boiler tubes, strength of reinforced concrete beams and columns, the relations between the strength and properties of structural steel and the chemical content of the steel, the strength of timber girders and timber joints. The proposed work includes tests on Illinois coals, strength of timber bridge stringers, strength of cast iron columns, and strength of eccentrically loaded structural steel members.

MUNICIPAL ENGINEERING WORKS OF ROCKFORD.

An illustrated paper by Mr. D. W. Mead (Chicago) described the deep-well water supply system of the city, in which centrifugal pumps at the bottom of a shaft (supplied by tunnels to the wells) are driven by rope transmission from vertical engines on the surface. This has been described in our columns. A paper by Mr. E. Main, the City Engineer, dealt with the paving, sewers, etc., and portions of this are given below:

We have 51 miles of improved streets, of which 2 miles are asphalt, 2 miles brick and 47 miles macadam. All requests for improved streets in the residence portion are for macadam. The City Council by resolution has adopted a uniform price of 25 cts. per lin. ft. as the amount for the property owner to pay for macadamizing, the balance of the expense is paid by general taxation. The city does the macadamizing; it owns a quarry, crushing plant, steam drills, steam rollers and all the necessary tools, and employs the labor for doing this work by the day, paying $3.50 to teamsters and $1.75 to laborers for eight hours' work. The average cost of macadam complete is $1.45 per lin. ft., divided as follows: Macadam, 29 cts. per sq. yd.; grading, 4 cts. per sq. yd., and curbing, 9 cts. per lin. ft.

Owing to the small amount paid by the property owners, the city does not feel justified in using anything but plank curbing, but is now considering raising the price to 50 cts. per ft. and using a cement curb. The following is a portion of our specifications:

The street shall be brought to a subgrade to conform to the finished grade of the street and rolled, it shall then be curbed on either side with 2 in. × 12 in. × 16 ft. soft pine plank, nailed to cedar posts 2½ ft. long, 4 ft. apart. There shall then be spread, from curb to curb, a layer of shoveled rubble, which after being thoroughly rolled shall be 4 ins. thick at the center and 2½ ins. at the curb. (What we call shoveled rubble is the stone just as it is blasted from the quarry and broken enough to be rolled.) Upon this foundation shall be spread a layer of crushed stone, ranging in size from 1½-in. to 4 ins. diameter; this layer when thoroughly compact by wetting and rolling shall measure 4 ins. in the center and 2½ ins. at the curb. The street shall then be finished with a layer of screenings not over ¾-in. in thickness and thoroughly wet and rolled with a roller of not less than 15 tons weight.

Most of our residence streets are macadamized to a width of 34 ft. and are crowned 18 ins., the center of the street being 9 ins. above curb grade and the gutter 9 ins. below. This we find to be the most satisfactory crown for streets varying in width from 34 to 40 ft., and a 15-in. crown where there are street car tracks. For durability it is very essential to crown a street sufficiently to at once carry the water to the gutter, it also greatly assists in street cleaning, as all the dirt that accumulates is washed to the gutter, and it is only necessary to clean out the gutter with the grader and haul the dirt away. This leaves the street practically as clean as when the macadam was completed.

Our asphalt pavements were laid by the Barber Asphalt Paving Co. at a cost of $1.75 per sq. yd., guaranteed for seven years. When the guarantee expired, it became necessary for the city to maintain the same. An experiment was made with what we call tar-macadam, a mixture of tar, pitch and crushed stone. It was satisfactory both in wearing quality and appearance, and we have used 2,100 sq. yds. in repairing our asphalt pavements. In a week after the repairs have been made, you could pass over the street and not know but that the repairs were made with asphalt.

The bottom layer of this tar-macadam consists of

crusher-run screenings not to exceed 1½ ins. diameter. This is thoroughly heated on a large boiler plate pan, care being taken to turn the stone, to prevent burning; to this stone is added a composition consisting of 2 parts of pitch to 1 part of tar, heated separately and then mixed together before applying to the stone. Enough of the tar composition is added to thoroughly saturate the stone, care being taken to thoroughly turn the same while the mixture is being added, so that it will be evenly distributed. This is put in place while hot and thoroughly rolled or tamped within ¾-in. of the finished surface of the pavement. Upon this surface is spread the finishing surface, which consists of hot crusher-run stone screenings, not to exceed ¾-in. diameter, using the same process as mentioned above. This is thoroughly rolled and left about ¼-in. higher than the pavement, so as to allow for settling. The expense of this repair work was 82 cts. per sq. yd., or less than half the price asked by the Barber Asphalt Paving Co., and I believe it will outwear the asphalt.

Our last brick pavement was laid on macadam foundation, made the same as our macadam streets and 5½ ins. below the finished grade of the street. We used 1½-in. sand cushion and Purington block with Portland cement filler. The cost was $1.23 per sq. yd. For brick pavement, we think the macadam foundation, when thoroughly rolled with a 15 or 20 ton roller, is as good as (if not better than) concrete, and in the future we expect to lay all brick pavements on macadam foundations.

ROADS AND STREETS.

In addition to Mr. Main's paper, there were two papers on street work—one by Mr. J. B. Hittell, Chief Engineer of Streets of Chicago, and the other by Mr. J. A. Moore, of the Board of Local Improvements, Chicago. Abstracts of these will be given separately. Mr. A. N. Johnson, the recently appointed State Highway Engineer of Illinois, presented a paper on "Highway Engineering," in the course of which he outlined the scope and character of the work proposed by the State Highway Commission. Stone is to be crushed at the penitentiaries, and it is suggested that the law be amended to allow convicts to be taken from the prisons and worked upon the roads. A system of investigating the actual amount of traffic upon country roads was also described, and a short abstract of this paper is given herewith:

The demand for highway engineers is rapidly increasing, and at present the supply is not equal to the demand. The need for this class of engineers is more and more appreciated as the people have seriously considered the problem of road improvement.

A proper organization for county or township road work should include at its head a man trained to road building, who should be responsible for purchasing material and keeping accounts, and who should outline a general method of improvement adapted to the local conditions. The district or other local superintendents should receive definite instructions from him and report directly to him. There would thus be some definite plan of action, so that each year a real improvement (even if small) would be made, and a marked change for the better would result in course of years.

Under the law establishing the State Highway Commission, the Commission is directed to compile statistics of road expenditures and road economics, and also to give advice to township officers in regard to the construction and repair of roads and bridges. Particular attention will be given to the maintenance and repair of dirt roads, which represent over 97% of the roads of Illinois. The investigation of road materials found in the State, the use of oil and tar upon roads, and other matters will be investigated. Whenever called upon, plans and estimates will be prepared for any proposed improvement, and one interesting work to be undertaken will be a traffic census of a number of roads throughout the State.

Prof. Talbot presented the report of the Committee on Good Roads Legislation. At the 1905 session of the Illinois Legislature a bill was introduced to appropriate $50,000 per annum as State aid to the construction of permanent roads. This aroused great opposition among the farmers in certain sections, but finally an act was passed establishing a State Highway Commission and making an appropriation of $25,000 per annum for the work of the commission, the "State aid" feature being omitted.

At the evening session of Jan. 18 Mr. M. O. Leighton, of the U. S. Geological Survey, described the object and work of the Reclamation Service. Mr. D. W. Mead showed slides of drawings and views of the Rockford water supply system, and Prof. L. S. Smith (University of Wisconsin) showed slides illustrating different designs of transits and levels.

SURVEYING.

The subject of surveying in its various aspects is always one of general interest, and was treated in several papers. Mr. C. A. Prout (City Engineer of Wheaton) discussed the subject of "Marking Corners," and recommended a concrete post 36 ins. long, 3½ ins. diameter at the top and 4¾ ins. at the bottom. The report of the Committee on Surveying dealt with the frequent removal and destruction of land marks and monuments on corners in the work of road improvement, and suggested that steps should be taken to call the attention of county commissioners and road supervisors to this matter. The Committee on the Licensing of Surveyors reported that no legislation had been enacted during the year, partly because the definition of a surveyor has not yet been determined. A disputed point is whether a "licensed surveyor" would be permitted to employ unlicensed men as assistants, the former taking all responsibility for the work of the latter. Until this can be settled by the surveyors among themselves it is probably useless to apply for any legislation. This relates particularly to land surveying. Mr. Mellnish (Bloomington) reported the progress of work on the geological survey of the State under the direction of the U. S. Geological Survey. A paper by Mr. J. T. Stewart (Paxton) described the methods employed in a government triangulation survey in Montana, and Mr. J. W. Woermann (Peoria) described the "Surveys of the Illinois and Desplaines Rivers," in connection with the proposed deep waterway from the Great Lakes to the Mississippi River.

Miscellaneous papers included were by Mr. L. K. Sherman (Joliet), on "The Relation of Engineering Design to Construction," and two papers on coal mine engineering. The first of these was on "The Springfield Coal Mine," by Mr. M. F. Peltier (Marion), and the second on "Track Construction in Mines," by Mr. Leo Gluck (Spring Valley). A paper by Mr. S. M. Woodward, on "Concrete in Farm Work," was very similar to one read at the meeting of the National Association of Cement Users, and recently noted in our columns. The report of the Committee on Architecture reviewed a number of matters and gave a somewhat qualified approval of concrete-block construction, the color and the "formal and artificial effect" of which are regarded as objectionable.

ENTERTAINMENTS AND ELECTION OF OFFICERS.

On the afternoon of Jan. 18 there was an excursion to the water-works pumping station and to the concrete shop building of the Ingersoll Milling Machine Co., which has been illustrated in our columns. On the return a visit was paid to the electric light plant. The same evening, after the close of the regular session, there was a banquet and social entertainment at the Nelson House, about 60 members and visitors being present. The election of officers resulted as follows: President, Dabney H. Maury; Vice-President, Edwin Main; Secretary and Treasurer, E. E. R. Tratman, Chicago. The next meeting will be held at Peoria, Ill., in January, 1907.

ANNUAL CONVENTION OF THE WOOD PRESERVERS' ASSOCIATION.

The second annual meeting of this association was held at the Palmer House, Chicago, on Jan. 16, 17 and 18. Mr. C. B. Lowry, Vice-President, occupied the chair.

The association had three committees charged with the duty of preparing specifications for different processes of timber preservation, but Mr. Lowry thought that no uniform standard specifications could be of general application, and he suggested that the committees be discharged. Mr. C. W. Berry (Union Pacific Ry.), Secretary of the association, considered that the subjects might well be discussed, and Mr. C. C. Crawford (U. S. Dept. of Agriculture) thought it would be well to investigate the effect of similar treatment on different kinds of wood. Eventually, however, it was decided to discharge the three committees and to appoint a new committee to consider what subjects should be taken up by the [illegible] during 1906.

TIMBER TREATING IN THE [illegible] STATES.—Mr. C. W. Berry (Union P[illegible] presented a statement of the amount [illegible] done in this country in 1905. The indi[illegible] returns were very dissimilar, so that it was difficult to classify them. The table below is [illegible] important as to broad totals:

Process.	Pilings and poles. lin. ft.	Lumber. ft. B. M.	Ties. No.	[illegible] Timber and [illegible] ties. pieces. B. M.
Creosote	4,384,901	24,944,963	77,120	[illegible]
Zinc & creosote	114,967	234,811	149,255	[illegible]
Creo-resinate ..	....	6,000,000	....	....
Burnetising ..	72,777	10,256,510	13,853,985	[illegible]
Wellhouse	432	258,163	1,101,230	....
Total	4,593,167	41,694,457	15,181,630	[illegible]

ZINC-CHLORIDE PROCESS FOR TIES.—There was a general discussion as to the proper amount of chloride to be used, and it was stated that where ¼-lb. to 1-3-lb. per cu. ft. had been used and afterwards increased to ½-lb. the smaller quantity appeared to give fully as good results as the larger quantity. Mr. Crawford (U. S. Dept. of Agriculture) stated that investigation had shown that the higher amount is not detrimental or injurious to the timber, but that the question is an economic one—the quantity must be sufficient to have the proper preservative effect, and not so excessive as to be a waste or useless expense. The amount will depend largely upon the character and condition of the wood and upon the climatic and other conditions of the place where the ties are to be used. In regard to the records of treated ties, Mr. Lowry (Columbia Creosoting Co.) stated that records kept previous to four or five years ago were quite valueless, but railways are now alive to the real importance of these records and the necessity of keeping them systematically. One speaker, however, thought that while the modern systems of records look well on paper, they are not actually kept up with much more accuracy than before.

SCREW SPIKES AND WOODEN TIE PLATE.—Several members referred to the use of wooden tie plates, or shims, which are now being experimented with by a number of railways. Their object is to prevent the mechanical wear of the tie by the rail. Mr. Lowry has been making and treating quantities of these shims, and believes them to be very efficient; they are not wider than the base of the rail and are as long as the width of the tie. Mr. E. E. R. Tratman (Associate Editor of Engineering News) was called on for information in regard to screw spikes, and referred to the recent revival of interest in these in this country. Roadmasters and section foremen are generally opposed to them, and find various defects in them; but it is significant that some roads have recently used them in large quantities under the direction of the engineers of maintenance-of-way. The South Side Elevated Ry. is a notable example, and both the Union Pacific and Southern Pacific railways are using them. In Europe they are commonly used, and there are no such troubles as are claimed to exist here. This may be due to a better design of the thread and general form of the foreign spikes. Mr. Lowry stated that he is shipping large quantities of ties bored for spikes, and endorsed the opinion as to the future extensive use of screw spikes. Some of the spikes in this country have certainly been defective in the form of the thread, but spikes are now being made here which are practically identical with those of the Eastern Railway of France.

WOOD BLOCK PAVING.—This committee report was prepared by Mr. A. Nestor (U. S. Wood Preserving Co.), and we give some extracts of this herewith:

Experiments are now being made by different companies and by the U. S. Government in order to obtain more exact knowledge as to the class of timber which may be successfully employed for various kinds of traffic, and also as to the size and character of the blocks and the method of treatment. The work of the committee may be divided into three classes:

1. Laboratory and service tests to determine the different classes of timber suitable for paving blocks. These tests embrace long-leaf yellow pine, Norway pine, tamarack and western larch, and will be extended by the U. S. government to include short-leaf pine, beech, sap

gum and turpentine. The U. S. Department of Agriculture has made arrangements with the cities of Minneapolis and Brooklyn for the laying of samples of blocks furnished by the Seattle River Quarries Co. and the U. S. Wood Preserving Co., respectively.

2. The size of block is to be investigated, and in the service tests of Minneapolis and Brooklyn blocks of different widths and depths will be used, and some information as to the proper relation of width to depth will probably be secured.

3. The amount and character of treatment will be investigated, and it is probable that they will be found to vary with the class of wood and with the character of the traffic which the blocks will carry. Abrasion and absorption tests may demonstrate either the advantages of hardening and waterproof materials in connection with creosote oil, or the employment of special grades of heavier oils in the treatment of blocks.

METHODS OF ANALYSIS.—Mr. C. W. Berry (Union Pacific Ry. tie preserving works) presented a paper describing the methods of taking samples of treated timber for analysis, and the methods of making the chemical analyses. This was of considerable length and accompanied by tables of results of experiments. The general conclusions were as follows:

1. The test retorts should be large enough to hold 100 grams of oil conveniently without danger of having the distillation unnecessarily prolonged by foaming. An 8-ounce retort is suggested.

2. Better results will be obtained if the retort is covered with asbestos.

3. The size of retort does not much affect the results of creosote analysis, provided the thermometer is placed in reference to the bend of the retort instead of in reference to the oil. The best position of the bulb of the thermometer would probably be ¼-in. below the bend. If placed at the bend there is danger of cooling.

4. The distillation should be continuous, the heat being regulated to finish the distillation in a specified time.

5. The use of a short-bulbed thermometer is advisable.

6. The number of degrees at which different fractions are taken should be limited to the smallest number possible for good results.

RAILWAY TIMBER TREATING PLANTS.—This paper was by Mr. D. Burkhalter, Superintendent of the Wood Preserving Works of the Atchison, Topeka & Santa Fe Ry., at Las Vegas, N. M. Some extracts from this are given below:

The intangibility of the results, arising from the deferred nature of the returns on the investment, operates often to bring into too prominent relief certain immediate apparent economies which may unfavorably affect the product. Sometimes the railway treating plant is organized to be merely another cog inserted in the ponderous machinery of the Operating Department, whereby its manager's chief concern becomes the smooth running of the plant instead of properly treating ties.

On account of the necessity for thorough organization in a railroad, it is necessary to conform at all times to the demands of the operating department; and it is possible to build a treating plant in which prompt handling of cars at full loaded capacity, and inexpensive switching which is both timely and sufficient, are a part of its natural economical operation. Its large tonnage output and questions of repair facilities often make location at a division terminal desirable, as water, steam and electrical supply may be consolidated with economy. The facilities furnished should be such as to allow of complying fully with the demands of other departments and not be so dependent on them as to suffer from their vicissitudes. If a round-house takes away water or air pressure at a certain time every day, the rush to get fixed for that is liable to turn out some underdone ties.

With many kinds of timber, previous seasoning is necessary, and in the zinc-chloride process, subsequent drying is also necessary to get the best results. This seasoning is preferably done in a storage yard; and the usual lack of synchronism between the supply of untreated and treated ties, and the natural movement and supply of empty cars, renders such a yard highly desirable as a sort of reservoir, even in a plant of small capacity. The installation of conveyors in such a yard will be a great step in advance and may be expected to display very marked economy over present methods. I have on several occasions seen two Mexicans, for $1.25 each, load on trams over 4,000 ties in a day, and I think that men could be got who would double that figure every day by the aid of machinery.

There is at least one device for getting treated ties into covered cars, but there should be many. And if the supply of road cars is, at some time of the year, large and composed of gondolas not going out of the direction of empty haul, such cars may be loaded by power, not to the present day large capacity, but to save a lot of money at the works, and to the track department in distributing them. I have seen it stated that the use of gondola cars for the distribution of treated ties saved $2 on every car unloaded, besides the additional speed obtainable with the work train.

I would go so far with the application of mechanical devices as to propose dumping the trams of ties immediately on exit from the cylinders. This might be done by a side dump with axis nearly under one rail and a friction brake with counterbalance. The empties would go at once a short distance to the re-loaders; and the chain carrying treated ties onto the loading platform would be the same arrangement now used by contractors to get ties from a river into cars. The loading platform has inclined sides with a road car loading on each side, and the ties are poked off with a pike pole like cakes of ice, quite different from our present slow method of handling and packing.

To load covered cars or box cars there should be a high platform and a chute in the doorway. Put this on wheels on a sidewalk, with a quarter circle and short extension which could be stood up to either end of the car, and I can foresee ten men loading 8,000 ties a day, or four times their present rating. Possibly the handling of ties which have been creosoted will increase the demand for such machinery. But in any event, such machinery is extremely desirable, both for reasons of economy and because at points where treating plants are usually located there is usually a pronounced labor problem; and for the same reasons the utilization of mechanical devices should be made to reach as far as possible.

Other papers were as follows: "Preservation of Timber and Its Application in Constructive Engineering," by P. F. Dundon (Puget Sound Creosoting Co.); "The Education of Timber Preserving Specialists," by F. D. Beal (Southern Pacific Ry. wood preserving works); "The Wood Preserving Industry," by C. C. Crawford (Chief of Section of Wood Preservation, U. S. Bureau of Forest Products); "Classification and Proper Condition of Timber for Treatment," by A. S. Case (National Lumber Co.'s wood preserving works).

The election of officers resulted as follows: President, C. B. Lowry; Vice-Presidents, E. O. Faulkner and Edmund Christian; Secretary, C. W. Berry (Union Pacific Ry.), Laramie, Wyo. The next meeting will be held in January, 1907, at Memphis, Tenn.

ANNUAL MEETING OF THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

The twelfth annual meeting of this society was held last week in the American Society of Mechanical Engineers' House, in New York City. The total registration, including guests, was 143, and all sessions were characterized by the greatest interest in the proceedings.

The first session was called to order by the President, Prof. Wm. Kent, at 2 p. m., Jan. 16.

After congratulating the society on its growth and increased interest, Prof. Kent, in his presidential address, gave a brief summary of the advance in heating and ventilating practice since the organization of the society, but remarked on the very trifling advance in scientific research and consequent dearth in available working formulas. No great difficulty is encountered by engineers in properly heating a building, but the problem of ventilation has met with almost as many failures as successes. These failures are mostly due to a limitation of the allowable cost of the system or the lack of expert advice in its design.

The ventilating problem is not easily solved. Each room should have given to it a quantity of air proportional to the number of persons in the room. The means provided for supplying fresh air to the building is usually either a fan placed in the basement which pushes the air into the several rooms, the air finding it way out through foul air exits, or else there is an exhaust fan in the attic or on the roof of the building, pulling out of the rooms the air which is admitted from the air inlet pipes. In the best modern practice the incoming air is warmed by steam coils in the basement before being allowed to enter the rooms. In some cases there is both a blower fan in the basement and an exhaust fan for foul air at the roof, but in all cases there is one main entrance to the building for receiving fresh air from out doors, and one main exit flue for the escape of foul air. Between the points of entrance and exit there are at least as many channels or pipes for the air to travel in as there are separate rooms. The areas of these pipes and their resistances due to friction to right angle bends, dampers, etc., may be calculated and adjusted so that, when air is quiet out doors and the fan or fans are running at a certain speed, the air delivered into each room may possibly be the amount calculated by the designer. I say "may possibly" and not "will certainly," because it is scarcely possible to design a system consisting of a large number of pipes varying in size, diameter and length leading from an air reservoir to another reservoir at lower pressure in which each pipe will deliver its due proportion of air. There is bound to be more or less "short circuiting" under the most favorable circumstances.

The next trouble is that if we have the pipes so perfectly designed that each one under the best circumstances will deliver its own calculated proportion of air, then the circumstances for which the pipes are designed are bound to vary every hour in the day. Some one of the rooms will have a crowd of people greater than was calculated, and they will remain longer in a room, polluting the air. Some one opens a window to let out the foul air and let in fresh, and immediately the whole circulating system is disarranged and thrown out of balance. If there is a wind blowing into the room it will blow back the incoming air supply and tend to increase the air supply of all the other rooms in the building. If, on the other hand, there is still air outside and the air from the heating coils enters the room under pressure, the opening of the window will establish a short circuit for this air to get outside by the window instead of going through the exhaust flues to the roof. Some air will enter the room on that account and one or more of the other rooms of the building will be robbed of its proper supply. The room that is thus deprived of its proper supply will then become not only foul but overheated and a window will have to be opened in order to cool and purify the atmosphere, and this will further disarrange the ventilating system. What is needed is such a system as will not be put out of balance when the doors or windows are opened in any one or more rooms of the building.

By the use of a few theoretical formulas and the "rules of thumb," supplemented by practical experience, the heating and ventilating engineer is enabled to provide a fairly satisfactory system for almost any building, but even the best are not entirely automatic and require constant attention on the part of the attendants.

The architectural profession is being gradually educated to the advisability, or the necessity, either of employing consulting engineers on all important work, or else of architects associating themselves with engineers as partners. The time seems to have arrived when the profession of architecture should be divided just as the engineering profession has been. We no longer have general engineers who are competent unaided to undertake the design of every detail of a plant which shall include in it matters belonging to several branches of engineering, such as civil, mechanical and electrical; we no longer have railway engineers, but engineers of maintenance of way, of motive power, and of electrical transmission and motive power. So also we should have artist architects, who could revel in designs of exteriors and interiors, and engineer architects, and these last should be divided into structural engineer architects, who would design the foundations and the superstructure, and architectural mechanical engineers, who would have to do with boilers and chimneys, pumps and piping, elevators, electric lighting, and heating and ventilation. The ideal arrangement of course would be the association of these three kinds of men in partnership, styled "architects and engineers." It ought to be generally recognized that no good artist can be an engineer, and no good engineer an artist.

The first business of the evening session was the report of the tellers, who announced the following officers elected: President, Mr. John Gormly, Philadelphia, Pa.; First Vice-President, Mr. C. B. J. Snyder, New York City; Second Vice-President, Mr. T. J. Waters, Chicago, Ill.; Secretary, Mr. Wm. M. Mackay, New York City; Treasurer, Mr. U. G. Scollay, Brooklyn, N. Y.; Directors, Prof. R. C. Carpenter, Ithaca, N. Y.; Mr. B. F. Stangland, New York City; Mr. James Mackay, Chicago, Ill.; Mr. Albert B. Franklin, Boston, Mass.; Mr. Frank K. Chew, New York City.

Following this a paper was read on "Heating and Ventilating the Main Auditorium of the Broadway Tabernacle," by Mr. C. Teran. It is printed in full in another part of this issue. In the general discussion which followed objection was made by Mr. Quay to the use of a direct-connected motor-fan unit for large sizes, due to the necessarily low speed motor in use and the great difficulty experienced should the speed ratio have to be changed. The general opinion seemed to be in favor of the belted motor whenever the room was available.

A paper was next presented on "Some Features of the Heating and Ventilating System in the

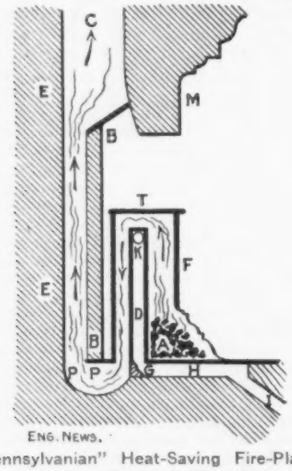
Bellevue-Stratford Hotel, Philadelphia," by Mr. Wm. G. Snow, of the Warren-Webster Co., Boston, Mass. This paper was interesting, principally due to the size of the building (18 stories) and the novel way in which many of the problems were solved. A departure from the common practice of locating fans in the basement was made by placing the main air supply fans in the attic, owing to lack of room below.

Mr. A. A. Cary, Consulting Engineer, New York City, gave a brief address in recognition of the 200th anniversary of the birth of Benjamin Franklin, the originator of what has been commonly recognized as American practice in heating and ventilation.

The part of Franklin's scientific investigations which appeals to us the most, is his invention between the years 1740 and 1745, of what he called the Pennsylvanian fireplace, which excellent design was afterwards imitated and changed until, in many cases, its original design and principle was entirely lost sight of, and we find many of these so-called improvements bearing the name, even to-day, of the Franklin Stove.

The real Franklin stove was not the mere iron fireplace which masqueraded under that name, but it was an apparatus which took cold fresh air from the outside of the house and after warming it in passages kept hot by the escaping gases of the fire, it was finally discharged into the room, and this old original Franklin fireplace, had it been enlarged and slightly altered and placed in the cellars of our houses, certainly would have become the prototype of all our hot air furnaces.

The speaker gave a short sketch of the history of Franklin's publications concerning heating and the waste and increasing scarcity of fuel. A sketch and quotations describing the stove in question were taken from an old edition (1806)



The "Pennsylvanian" Heat-Saving Fire-Place, Invented by Benjamin Franklin.

(Fac-simile of cut in Franklin's Works on Philosophy, Politics and Morals, 1806); by courtesy of Mr. A. A. Cary, New York City.)

of Franklin's works. The following is a description of the fireplace as given in "Franklin's Works on Philosophy, Politics and Morals," and refers to a cut in this book, a fac-simile of which is shown:

1. A false back of 4-in. (or, in shallow small chimneys, 2-in.) brick work is to be made in the chimney, 4 ins. or more from the true back; from the top of this false back a closing is to be made over to the breast of the chimney, that no air may pass into the chimney, but what goes under the false back, and up behind it.

2. Some bricks of the hearth are to be taken up, to form a hollow under the bottom plate; across which runs a thin, tight partition, to keep apart the air entering the hollow and the smoke; and is therefore placed between the air hole and smoke holes.

3. A passage is made, communicating with the outward air, to introduce that air into the fore part of the hollow under the bottom plate, whence it may rise through the air hole into the air box.

4. A passage is made from the back part of the hollow, communicating with the flue behind the false back; through this passage the smoke is to pass.

The fireplace is to be erected upon these hollows, by putting all the plates in their place and screwing them together.

Its operation may be conceived by observing the plate entitled "Profile of the Chimney and Fireplace."

M The mantel-piece, or breast of the chimney.
C The funnel.
B The false back and closing.
E True back of the chimney.
T Top of the fireplace.
F The front of it.
A The place where the fire is made.
D The air box.
K The hole in the side plate, through which the warmed air is discharged out of the air box into the room.
H The hollow filled with fresh air, entering at the passage I, and ascending into the air box through the air hole in the bottom plate near.
G The partition in the hollow to keep the air and smoke apart.
P The passage under the false back and part of the hearth for the smoke.

The arrows show the course of the smoke.

The fire being made at A, the flame and smoke will ascend and strike the Top T, which will thereby receive a considerable heat. The smoke, finding no passage upwards, turns over the top of the air box and descends between it and the back plate to the holes in the bottom plate, heating as it passes, both plates of the air box, and the said back plate; the front plate, bottom and side plates are also heated at the same time. The smoke proceeds in the passage that leads it under and behind the false back and so rises into the chimney. The air of the room, warmed behind the back plate, and by the sides, front and top plates, becoming specifically lighter than the other air in the room, is obliged to rise; but the closure over the fireplace hindering it from going up the chimney, it is forced out into the room, rises by the montel-piece to the ceiling, and spreads all over the top of the room, whence being crowded down gradually by the stream of newly warmed air that follows and rises above it, the whole room becomes in a short time equally warmed.

At the same time the air warmed under the bottom plate, and in the air box, rises and comes out of the holes in the side plates, very swiftly, if the door of the room be shut, and joins its current with the stream before mentioned, rising from the side, back and top plates.

The air that enters the room through the air box is fresh, though warm; and, computing the swiftness of its motion with the areas of the holes, it is found that near ten barrels of fresh air are hourly introduced by the air box; and by this means the air in the room is continually changed, and kept, at the same time, sweet and warm.

The third session was opened at 2.30 p. m. by the reading of a paper entitled "Arrangements for the Ventilation of the Debating Room of the New Riksdag's Building in Stockholm, and the Results Obtained in This Respect," presented by Wilhelm Dahlgren, Stockholm, Sweden, and read by the Secretary. In the informal discussion which followed the reading of this paper it seemed to be the general opinion that the inefficacy of downward ventilation had not been proven by this individual case, and that either system can be made satisfactory if proper care is taken to overcome the various difficulties as they arise.

The committee appointed at the previous annual meeting for the collection of data on furnace heating presented a printed report. This consisted of the answers to a series of 18 questions relating to important details in the design of a particular house, specified in the questions. Following this report two topics were informally discussed. These were: "The Increased Tax on Indirect Heating Apparatus Due to the Use of Partition Flues, Owing to Their Shape and Restricted Area," and "The Difference Between the Theoretical Estimate and the Actual Consumption of Fuel Required for Heating Buildings."

Following adjournment the annual dinner of the society was held at the New Grand Hotel.

Mr. T. N. Thomson, of the International Correspondence School, opened the Thursday morning session by reading a paper on "Power Required to Thread, Twist and Split Wrought-Iron and Mild-Steel Pipe." This paper is the result of considerable investigation by the author and the National Tube Co. as to the strength of welds of commercial pipe and the best design of dies to prevent opening the welds during the process of threading. The results seemed to show that the dies in use at the present time had insufficient rake, many having a radial cutting face, with the cutting edge nearly a right angle. Experiments indicated that 12° for wrought-iron and 20° for mild-steel pipes were the best cutting angles, while a clearance or relief should be given to the die, so that it will bear on the pipe only at the cutting edge. The power which must be applied to the die-stock in threading and the consequent strain on the weld is greatly reduced by this design.

The accompanying table is a summary of tests made by the International Correspondence School wrench would be recorded on the spring balance. hand tools. The pipe under test was supported horizontally by passing through holes in two wooden uprights. A vise, which was clamped on the pipe, was bolted to a wooden lever, which in turn was supported by a spring balance about 18 ins. from the center of the pipe. Any torsional strain put on the pipe by a die or a Stillson to find out what takes place at the pipe-vise with

The next was a paper on "Sizes of Return Pipes in Steam Heating Apparatus," by Mr. J. A. Don-

Approximate Power Required (Pounds) to [illegible] and Split Pipe. Summary.

Kind of pipe.	To Thread; well oiled; steady pull at 16-in. leverage on die-stock arm. New rake dies. Lbs.	New common dies. Lbs.	Old common dies. Lbs.	To Twist. Steady pull with Stillson's. Lbs.	[illegible] with Stillson's. Lbs.	Margin of safety. Lbs.
¼-in. Steel (4 samples)	34.5	56.25	60.5	122.5	[illegible]	73.85
½-in. Iron (7 samples)	27.14	33.14	49.14	102.14	[illegible]	48.12
¾-in. Steel (4 samples)	44.25	60.5	90.75	150.	[illegible]	122.05
¾-in. Iron (8 samples)	44.375	51.25	73.5	140.	170.43	80.88
1-in. Steel (5 samples)	68.8	111.	124.	286.	[illegible]	258.8
1-in. Iron (7 samples)	62.14	105.7	118.57	272.85	[illegible]	172.52

nelly. The object of the paper was to furnish the profession with more accurate and extended information on this subject in place of the inadequate "rule of thumb" given in text-books.

Under the head of Topical Discussion, the following subjects were considered: "The advantage in placing check-valves on return connections of steam radiators, discharging into a single down-pipe from an over-head steam main, returning to a receiver; and, if so, can check-valves be used of smaller size than the return connection?" and "The advantage of automatically venting the extreme ends of steam mains in the basements on low-pressure gravity steam heating apparatus, and the proper mode of connection."

Two papers were read in the afternoon session—"A New Vapor Vacuum System of Heating," by Mr. J. A. Donnelly, and "Forced Draft for Boilers," by Mr. L. J. Wing, 136 Liberty St., New York City. This latter paper is in defense of the use of forced draft to the exclusion of tall chimneys. The efficiencies of the different methods of forced or induced draft are compared.

Installation of the new officers followed, and final adjournment.

ANNUAL CONVENTION OF THE INDIANA ENGINEERING SOCIETY.

The twenty-sixth annual convention of this society was held in the rooms of the Commercial Club, at Indianapolis, on Jan. 18, 19 and 20. The attendance was unusually large. The papers presented at the first session, with the exception of the President's address, were devoted to mechanical engineering topics.

The address of the President, Mr. R. P. Woods, M. Am. Soc. C. E., of Indianapolis, was a historical review of the progress of engineering in all its phases and for all times. The discussion was subdivided as to time under three heads—ancient, medieval and modern engineering—and the progress of the various special fields of engineering developed under modern conditions was clearly set forth. The relations of the various branches one to the other was shown and the importance of association of engineers in all fields from time to time was pointed out.

The report of the Committee on Mechanical Engineering, presented by Prof. J. D. Hoffman, reviewed the progress in this field within the State of Indiana during the past year. According to this report, water power developments are in progress on the Tippecanoe River and at Muncie; steam power plants, electric lighting stations, both municipal and private, water-works plants and central heating and power plants are under construction in various towns and cities. Detailed reference was made to the many electric railway projects throughout the State, some of which are under construction and others proposed; and the power plants at Anderson and Rushville were mentioned as models of their class. The proposed consolidated plant for the Fort Wayne & Wabash Valley Traction Co., at Fort Wayne, which is to use steam turbines, was also referred to. Attention was drawn to the tendency to consider the economies of operation in the design of industrial plants throughout the State. The report concluded with brief mention of the new plant at Purdue University for test-

ing automobiles, and of the movement toward smoke abatement in Indianapolis.

A short paper giving a "Comparison of the Minute Structure and Strength of Some Woods" was read by Prof. M. J. Golden. The slides showed the structure of the woods by means of radial, longitudinal and cross-sections. The species included the pines, sycamore, oak, hickory, maple and elm. The discussion was directed more particularly to the characteristics which chiefly affect the usefulness of the timber for structural purposes.

A paper by Mr. R. P. King, formerly Smoke Inspector for the city of Indianapolis, discussed the merits of the soft coal mined in the southwestern part of the State of Indiana. The output of the Indiana mines during the year 1904 was about 12,000,000 tons, and this amount would probably have been increased by perhaps 25% during 1905 but for the scarcity of cars. A visit to the mines near the close of the latter year showed an average of about one car per mine at some 30 mines, and the terminals were quite generally crowded with loaded cars. In the Indiana coal district at least seven workable coal veins have been found. Comparative figures for the cost per horse-power year at a water power plant on the Connecticut River and for steam plants at Indianapolis showed for the former an actual cost of $20, which was increased to $26.72 when interest and fixed charges were added; while the Indianapolis costs varied from $21 for large steam plants to $27.20 for small plants. Attention was called to the dearth of published analyses of Indiana coals; also to the marked variations of practice in different local plants in such details as grate area, furnace dimensions and related parts. The paper closed with a plea for the more extended use of Indiana coals.

Mr. R. C. Stevens, of the Atlas Engine Works, presented a paper on the "Power Required to Operate Machine Tools." This paper described a series of experiments made by the writer under actual working conditions, the machines being electrically driven by individual motors. The discussion of the paper brought out some interesting points on the effect of introducing the use of high-speed steel, a common result being the failure of the old machine tool in whole or in certain details, with a considerable increased demand of power in the motor; in one such case the power was increased from 5 to 15 HP., with the old machine still giving satisfactory results.

The first session closed with a group of three papers by members of the staff of Purdue University. Mr. P. V. A. Diserens described the "Equipment Used for Testing the Boilers at the Purdue University Power Plant," including the special facilities for testing the plant singly or by groups under actual working conditions. Prof. W. P. Teague described "The Purdue University Automobile Testing Plant," an article on which appears on another page of this issue of Engineering News. A paper on "The Effect of Lead and Aluminum on the Strength of Cast Iron," by Prof. L. V. Ludy, gave results of tests made on samples cast and broken at Purdue University. In general, it was found that the alloying caused a reduction in the strength and stiffness of the metal by varying percentages.

At the annual banquet, the first of the kind held by the society, the speakers were President Woods, Secretary Brown, Prof. R. L. Sackett, Messrs. C. A. Kenyon, D. V. Moore, A. J. Hammond, H. B. Marsh, E. Bross and Prof. W. D. Pence.

At the Friday morning session the first report was presented in outline by Professor Pence, chairman of the Committee on Railroads. The report, as printed in the Proceedings of the society, will include cuts of the various standard roadbed plans of both steam and electric roads operating in Indiana, together with a classification of the roads.

A paper on "The Creosoting Plant at Shirley, Ind.," by Mr. H. H. Knowlton, Assistant Engineer, C., C., C. & St. L. Ry., described the plant and its operation in full detail. Mr. H. O. Garman, of Purdue University, gave the results of a mathematical study of the reliability of four methods of figuring overhaul in railway earthwork construction. It was found that the methods included in the comparison gave results very close to the rigid method adopted as a basis of comparison. Mr. Hugo Diemer read a paper on "Industrial Engineering," which advocated the intelligent analysis of costs, with a view to determine a true economic basis in the field of productive engineering. It was urged that the "production engineer" should have the accountant's keen sense for analyzing costs, and that he should be able to give expert opinions, the same as an attorney, for the guidance of the industrial concern; that he must be able to execute as well as design; and also to deal with men as well as machines. The paper advocated a broad and liberal training for men who occupy the position of shop superintendent, and favored the merit wage system, with workmen as demonstrators for the less skilled men, so as to stimulate the spirit of the shop forces.

The report of the Committee on Bridges and Masonry, presented by Mr. A. J. Hammond, described three notable bridges completed during the past year within the confines of the State—the bridge over the Wabash River at Terre Haute, the largest highway bridge in the state, costing $271,000; the Colfax Ave. plate girder bridge, 630 × 54 ft., and the reinforced concrete arch on Jefferson St., both at South Bend, spanning the St. Joseph River. The report also referred to the general movement in the larger cities of the State toward the adoption of solid floors for highway bridges, the preferred form in many places being of concrete reinforced by steel bars, usually the corrugated type.

The report of the Committee on Electrical Engineering, Mr. J. B. Nelson, chairman, outlined the progress in this field during the past year, describing the practice in lighting and power plants. The mileage of interurban railways in operation at this time in the State of Indiana was estimated at 1,026, and the summary of other systems now under construction showed that within a few months this total will be increased by several hundred miles additional.

On Friday afternoon the members of the society were given a complimentary ride over the newly constructed Indianapolis & Cincinnati Traction Co.'s line to Rushville, where the power station is located. This line (Eng. News, April 6, 1905) has become widely known as the first single-phase system in successful operation. At the power station work was in progress installing steam turbines, and extensions were being made to the shop buildings. On the return trip several consecutive miles were run in 55 secs. per mile. The roadbed, track and structures conform in quality to the best grade of steam road construction. Except near the terminals, there is but one track at present, but the roadbed and bridges have been built for a second track, which will be added in due time.

The program for Friday evening consisted of four papers, with the use of the lantern. Mr. M. O. Leighton, Hydrographer, U. S. Geological Survey, described the "Engineering Construction by the United States Reclamation Service." Mr. L. H. Gibson, Architect, of Indianapolis, discussed "Art and Engineering." Prof. W. D. Pence described the "Recent Developments in the Drainage of the Kankakee Marsh." "A Decade of Bridge Building in Marion County," by Mr. H. W. Klausmann, County Engineer, Indianapolis, described the movement in permanent highway bridge construction in the vicinity of the State capital.

The closing session included a paper by Mr. Charles Brossmann, Jr., of Indianapolis, on "Water Purification as a Municipal Problem"; by Prof. R. L. Sackett, of Earlham College, Richmond, on "A Combined Water Supply and Electric Light Plant for Towns"; by Prof. A. D. Hole, of Earlham College, on "The Economic Value of a Topographical Survey of the State of Indiana"; by Mr. E. W. Hyde, of Purdue University, on "A Problem in Hydraulics"; by Mr. J. S. Spiker, of Vincennes, on "Cement Testing, Concrete, Street Grades and Brick Pavement"; by Mr. E. E. Watts, on "The Sewerage of Princeton, Ind."; and a report of the Committee on Roads and Pavements, by Mr. J. W. Fulwider, of Lebanon.

The officers elected for the ensuing year are: President, Mr. R. P. Woods; Vice-President, Mr. E. E. Watts; Trustees, Messrs. W. F. M. Goss and B. F. Nesbit.

THE NEW CROTON DAM was officially completed by laying the last stone in coping on Jan. 17. The dam was begun 13 years ago. It has a maximum height of 300 ft., half or more of which is below ground, and will impound some 32,000,000,000 gallons of water.

ARGUMENT ON THE CHICAGO DRAINAGE CANAL case was begun before the U. S. Supreme Court on Jan. 2. As many of our readers know, St. Louis, or the State of Missouri on its behalf, is seeking an injunction against the discharge of the sewage of Chicago through the drainage canal into the Des Plaines, Illinois and Mississippi rivers, claiming that its water supply is injured thereby.

TWO FLAT CARS OF 100 TONS CAPACITY are nearly completed for the Allis-Chalmers Co. at the West Milwaukee shops of the Chicago, Milwaukee & St. Paul Ry. They are designed for the carriage of very heavy pieces of machinery, and one will be used as soon as completed to transport an 80-ton bed plate casting for a blowing engine at the Sharon plant of the Carnegie Steel Co. The cars will have 16 wheels and will be 41 ft. long.

BALANCED BIDS are to be attacked by Mr. Bird S. Coler, the new Borough President of Brooklyn, N. Y. It appears that Brooklyn sewer contractors have been bidding 1 ct. per cu. yd. for concrete cradles for sewer pipe, in the belief that no concrete would be required.

ADDITIONAL SUBWAYS are recommended in a special report of the Boston Transit Commission. Among the recommendations are that the present subway under Boylston St. be extended with openings in Copley Sq. or to the west on Huntington Ave. and Boylston St.; that the East Side subway act be amended so that the subway can be built further from Washington St.; that the East Boston tunnel and the Cambridge subway should not be connected at grade with Tremont St. subway, but that they should end in loops or be extended. The Commission further suggests several routes for the Back Bay subway. One is under Commonwealth Ave. from the junction with Beacon St., under the Public Garden and Common to a loop at Park St. Another is the proposed route under the new Charles River embankment. A new subway connecting the Huntington Ave. and Columbus Ave. tracks by a loop passing the South Station via Eliot, Kneeland, Summer and Winter Sts., is suggested. Another proposal is for a subway under Winter and Summer Sts., connecting Park St. with the South Station. A loop is planned at the North Station for cars using the present subway.

A STREET IMPROVEMENT LOAN of $2,000,000 has been provided at Baltimore, Md., and will be available at the rate of $500,000 a year, beginning with 1906. The money will be expended under the direction of the Commissioners for Opening Streets, and will be used for opening, grading and paving. In addition, there is talk of a $5,000,000 loan for paving work.

FREIGHT TRAFFIC ON NEW YORK STATE CANALS during 1905 amounted to 3,226,896 tons, as compared with 3,138,547 tons in 1904. The season was favorable to canal navigation, but a shortage of boats has resulted, it is said, from the cessation of building of boats suitable to the present canal. This is attributed to the construction of the barge canal, now in progress. Mr. N. V. V. Franchot is in charge of the canals.

THE JOHN FRITZ MEDAL HAS BEEN AWARDED to George Westinghouse, of Pittsburg, Pa., for the invention and development of the Air Brake. This is the second award of the medal, the first being made two years ago to Lord Kelvin. The medal was founded on August 21, 1902, by the friends and colleagues of John Fritz, of Bethlehem, Pa., on his eightieth birthday. Its award is made by a board of sixteen, at present made up of the following: For the American Society of Civil Engineers, Alfred Noble, Charles Warren Hunt, Charles Hermany, and C. C. Schneider; For the American Institute of Mining Engineers, James Douglas, Charles Kirchhoff, E. E. Olcott, and E. G. Spilsbury; For the American Society of Mechanical Engineers, R. W. Hunt, S. T. Wellman, J. M. Dodge, and J. E. Sweet; For the American Institute of Electrical Engineers, C. P. Steinmetz, C. F. Scott, B. J. Arnold, and J. W. Lieb, Jr.

THE BRAZILIAN BATTLESHIP "AQUIDABAN" blew up at Rio Janeiro on Jan. 22. It is said that the ship's magazine exploded. The vessel sank in a few minutes; several hundred lives were lost. The vessel was built in England in 1885, was used by Admiral

Mello in 1894 in the revolt against the Brazilian government, was sunk by a torpedo in 1894 and in the following year was raised and was reconstructed.

A DERAILMENT ON THE BROOKLYN ELEVATED railway of the Brooklyn Rapid Transit Co., New York City, on Jan. 19, is peculiar because it is the second case in the history of the elevated railways of New York City of a car falling to the street. An east-bound train on the Lexington Ave. line was derailed at a switch where the line to Rockaway Beach turns off. The switch had been spiked shut for some months past, but the spikes were drawn on the day of the accident for a special trip on the branch line. The second car of the wrecked train, it appears, split the switch, was derailed, ran across the roadbed and fell to the street. The first car was dragged across the west-bound track; the other cars stayed on the rails. One person was killed in the wreck. The first accident similar to this occurred on the Ninth Ave. line of the Manhattan Ry. at the junction switch where the Sixth Ave. line turns off. That accident was noted in our issues of Sept. 14 and Oct. 5, 1905.

THE BOILER EXPLOSION on the "Bennington" has been finally adjudicated by the acquittal of Ensign Wade, who was in charge of the engine-room of the vessel. The U. S. gunboat "Bennington," lying in San Diego harbor, was wrecked on July 21, 1905, by a boiler explosion, and sixty men were killed. It was determined that the boilers were in indifferent condition and that the safety valves were not in working order. A board of inquiry recommended that the commander of the vessel, Young, and the engineer in charge, Wade, be court-martialed. The court-martial of Commander Young sentenced him to be reprimanded. The court-martial of Ensign Wade found him not guilty, and on being reconvened by the Secretary of the Navy it reaffirmed its finding. The other persons to whom responsibility might attach were killed in the accident. The accident was noted in our issues of July 27, 1905, p. 103, and Aug. 24, 1905, p. 210, the latter giving a report of the findings of the Board of Inquiry.

SUITS FOR OVERCROWDING CHICAGO STREET cars have been instituted in behalf of the city. The claims are for the collection of penalties of $100 per day per car for overcrowded cars in December alone, and aggregate $2,000,000.

A PUBLIC HEATING AND COOLING PLANT is projected at Washington, D. C. A bill for the incorporation of the Economic Heating & Refrigerating Co. is before Congress and has been approved by the Commissioners of the District of Columbia.

THE ONE-PRICE SYSTEM for canal excavation, regardless of the class of material encountered, is declared satisfactory by Mr. Henry A. Van Alstyne, State Engineer of New York, in his annual report for 1904. He says that the contract prices (on six awards) were probably as low as could have been obtained otherwise, and that in the "execution of the contracts there has been no occasion for the frequent disputes and differences of opinion so common under the old method, as to just what material should be classified as earth or as rock."

A MOTOR-OMNIBUS COMPANY at Birkenhead, England, has proven to be such a competitor of the municipally-owned street railway system, according to the London "Surveyor," that the borough has waked up to the possible fact that the motor 'bus company has no rights to the streets and now proposes to seek an injunction against the company. The borough alleges that the 'buses will increase the tax rates on account of wear and tear on the streets.

A NORMAL CHLORINE SURVEY of the waters of Michigan is to be made by the Michigan State Board of Health, in cooperation with Prof. Delos Fall, of Albion College, a former member of the board. The State Board of Health also proposes to cooperate with the State engineering and medical societies in an attempt to secure legislation creating a commission to investigate and advise regarding public water supplies. Prof. Victor C. Vaughan, of Ann Arbor, is president, and Frank W. Shumway, M. D., Lansing, is secretary of the State Board of Health.

HIGH PUMPING FOR IRRIGATION is a notable feature of engineering work in the Hawaiian Islands. The Allis-Chalmers Co., of Milwaukee, has supplied 29 installations for various companies in the islands named. Of these 29 installations all but four are for heads of more than 100 ft. Two plants work against a head of 775 ft., one having a daily capacity of 12,000,000 and the other of 6,000,000 gallons. A number of other 12,000,000-gallon plants have been provided for heads of from 120 to 450 ft. A single company has six installations of from 2,000,000 to 12,000,000 daily capacity, each, and another one has a like number, with capacities from 6,300,000 to 12,000,000 gallons, aggregating 53,250,000 gallons a day.

CAUTION ADVISABLE IN THE USE OF REINFORCED CONCRETE.—Buildings of 18 stories in height are being erected in which the skeleton is of reinforced concrete. Considering that the use of steel for reinforcing concrete beams was not suggested until 1882, a development of this character is certainly remarkable, and we have reason to pause and consider whether such extreme development is wise.

While visiting a large city recently I had occasion to inspect a building several stories in height, in which cinder concrete was being used in the structural parts. The contractor, in reply to my surprised query, stated that the building was still standing. This was indeed true, but what was the margin of safety in this structure? As this concrete had a compressive strength of about half what could be expected from a fairly good concrete, the factor of safety had been cut in half. In further explanation the contractor stated that in order to compete with other contractors he was obliged to use the same materials which they did.

The use of inferior materials should not be permitted in reinforced concrete construction, and the present situation in the development of concrete and reinforced concrete is one that should be faced squarely. That it is possible to erect a 16-story building of reinforced concrete has been demonstrated, but we should have a better knowledge of the properties of this material before such a practice becomes general. Ten years or less experience with a material in which chemical changes are constantly going on, and which may be affected by the changes produced by expansion and contraction, is hardly sufficient to enable us to obtain a thorough knowledge of its properties.—(Extract from the address of President R. L. Humphrey at the annual convention of the Cement Users' Association.)

PERSONALS.

Mr. Colin R. Wise, M. Am. Soc. C. E., has been appointed county engineer of Passaic Co., N. J. Mr. Anton L. Pettersen has been appointed to fill the unexpired term of Mr. Wise, as City Surveyor of Passaic, N. J.

Mr. William Burton, engineering aid and Mr. J. T. Keenan, assistant engineer in the Reclamation Service, have resigned. Mr. J. G. Little, structural engineer, has been transferred from the Washington Office to Williston, N. D.

Mr. A. P. Greenfelder, Jun. Am. Soc. C. E., has resigned as Principal Assistant Engineer of the Terminal Railroad Association of St. Louis, to accept the position of Superintendent for the contracting firm of Fruin & Colnon, of St. Louis, Mo.

Mr. W. D. Taylor, M. Am. Soc. C. E., has resigned his position as Professor of Railway Engineering at the University of Wisconsin, Madison, Wis., and beginning Feb. 1 will be Chief Engineer of the Chicago & Alton Ry., whose service he left 4½ years ago to accept his present position.

Mr. F. C. Kunz, M. Am. Soc. C. E., has been advanced from the position of Engineer of Construction to that of Chief Engineer of the Bridge and Construction Department of the Pennsylvania Steel Co., Steelton, Pa.

The address of Mr. J. E. Zalles, secretary of the commission in charge of the projected extensions of the Bolivian National Railways, is La Paz, Bolivia.

Mr. Geo. A. Ricker, M. Am. Soc. C. E., and consulting engineer, of Buffalo, and Prof. Nathaniel W. Shed, chemist and metallurgist of the Buffalo Foundry Co., have incorporated the Buffalo Testing Laboratory, and have established an inspection bureau, in charge of Mr. M. E. Biggan, formerly with R. W. Hunt & Co. and at one time superintendent of the rail finishing mill at Sparrows Point. The associated engineers will make a specialty of inspection service, in connection with contract work at the Lackawanna Steel Works.

Obituary.

Carl Christian Adolph Both, M. Am. Soc. C. E., Assistant Engineer in the U. S. Engineer's Office, at Portland, Me., died on Jan. 19.

George Foote, resident engineer of the old Vera Cruz Railway, of which he was for several years general manager, died in Mexico City, Mex., Jan. 17.

Charles A. Silliman, a trustee of Columbia University, died Jan. 19 at Troy, N. Y. Mr. Silliman was graduated from Columbia University in 1859. He was Dock Commissioner of New York City under Mayor Hewitt.

J. Frank Seavey, M. Am. Soc. M. E., First Assistant Engineer in charge of the Drafting Department of the Bethlehem Steel Co., South Bethlehem, Pa., died [illegible] of pneumonia at South Bethlehem. Mr. [illegible] was a man of marked engineering ability and of [illegible] character.

Major Geo. B. Hubbard, U. S. A., died [illegible] at St. Vincent's Hospital, New York City, at the [illegible] of 72. He served in the Civil War and later became [illegible] in railroad and mining construction work. He was [illegible] superintendent of construction of the Ellis Island [illegible] ration Station, New York City.

C. H. Hines, Asso. Am. Inst. E. E., died [illegible] at Puebla, Mex. Mr. Hines was a pioneer in [illegible] railway work in this country. Under Mr. Leo [illegible] he assisted in equipping the cars used in the [illegible] pioneer experiments on the New York elevated road. [illegible] he was engaged in power-plant construction in the country, Mexico and South America. Among the many positions he held were Constructing Engineer for the General Electric Co.; Electrical Superintendent, Lorain Steel Co.; Electrical Engineer, Canadian Pacific R. R.; Consulting Engineer, Erie R. R. Later he became interested in gold mining in the United States of Colombia. Mr. Hines was the inventor of a number of valuable appliances in electrical engineering.

ENGINEERING SOCIETIES.

COMING MEETINGS.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 30 to Feb. 2. Annual meeting at King Edward Hotel, Toronto, Can. Sec'y, C. H. McLeod, 877 Dorchester St., Montreal, Can.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 21. Annual meeting at South Bethlehem, Pa. Sec'y, R. W. Raymond, 99 John St., New York City.

ILLUMINATING ENGINEERING SOCIETY.—In the list of officers of this society, appearing in our last issue, the name of Dr. Arthur H. Elliott should have appeared as a director. It is Dr. Elliott who is Chief Engineer of the Consolidated Gas Co., and not Mr. E. L. Elliott as was erroneously stated.

ALUMNI ASSOCIATION OF THE RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.—The mid-winter meeting will be held in Washington, D. C., Feb. 2. During the day visits will be made to the Naval Gun Factory, the Filtration Plant, the New Union Station and the Connecticut Avenue Bridge. In the afternoon the members of the association will be received by President Roosevelt in the parlors of the White House. A banquet will be served at the New Willard Hotel at 8 o'clock in the evening.

The meeting has been arranged by a committee in Washington consisting of Rear Admiral M. T. Endicott, Chairman, Rear Admiral C. W. Rae, General F. G. Smith, Messrs. S. W. Tullock, A. C. Cunningham, A. J. Norris, C. C. Arosemena, C. A. Bostrom and C. B. Hunt, Secretary, assisted by Mr. A. P. Boller, of New York, President, and Prof. E. F. Chillman, of Troy, Secretary of the Association.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The Board of Directors has received from the Institution of Electrical Engineers of Great Britain an invitation to the Society to visit England during the latter part of next June. A similar invitation has been received from the Associazione Elettrotecnica Italiana to visit Italy during the season of the Industrial Exhibition at Milan beginning May 1, 1906.

These invitations are in acknowledgment of the courtesies extended to both organizations by the A. I. E. E. It will be remembered that large representative bodies from both these societies took part in the Circular Tour, on the occasion of the International Electrical Congress at St. Louis, September, 1904, and participated in a joint meeting at St. Louis.

Both of the proposed tours will embrace visits to important electrical plants, educational centers and scenic features of these countries.

MINNESOTA SURVEYOR'S AND ENGINEER'S SOCIETY.—At the annual meeting held in the city of St. Paul, Minn., about thirty were present. The following papers were presented: "The County Surveyor," by Mr. O. H. Case, County Surveyor of Fillmore County; "Some conditions confronting the Highway Commission," by Mr. Chas. A. Forbes, County Surveyor of Dakota County; "Reinforced Concrete," by Mr. C. A. P. Turner, Consulting Engineer, Minneapolis; "Sewage Disposal," by Mr. L. P. Wolff, Consulting Engineer, St. Paul, Minn.; "Foundations," by Mr. Geo. W. Sublette, Consulting Engineer, Minneapolis; a paper outlining the work already done by the State Topographical Survey, by Mr. John Abercrombie, Chief Engineer of this survey. Addresses were also given on "Good Roads" by Mr. Geo. W. Cooley, secretary of the State Highway Commission; and on sewage disposal questions, by Dr. H. M. Bracken, of the State Board of Health. The following are the new officers: President, J. E. Hill, St. Cloud, Minn.; Vice-President, C. W. Gove, Windom, Minn.; Secretary and Treasurer, Arthur E. Morgan, St. Cloud, Minn.

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